ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

What in the World!

How far should a utility go in extending to delinquent customers the privilege of continued service? Long an important question, it assumes new significance when the affairs of consumers and company alike are drawn into a common economic maelstrom. As in many other policy matters, it appears that local conditions and local company-customer relationships must rule over glib generalizations and too rigid rules. Bread cast upon the waters still returns after many days.

●

Pressure upon light and power enterprise continues through both earnings and expenses. Lower rates widely demanded—and obtained. Obtained in spite of higher and discriminatory taxes, higher-wage pacts, slow-pay and uncollectible bills and more formidable competition. Add to those problems the renewed plea for straight-line depreciation practices, now actively sponsored by the New York Commission, in place of the depreciation-reserve system, so long the utility company preference and practice, and there is ample reason to realize that a utility executive's life is not a happy one.

●

Convention season is here again. Not in the familiar numbers, not with the one-time customary type of program, not with the same spirit on the part of participants, but nevertheless here again. Strongly dominating the meetings of today is the highly practical commercial spirit. Manufacturers, utilities, wholesalers and contractors must push the sale of their product, service or activity if the newly formulated promises of the New Deal are to be survived.

●

More efficiency at the manufacturing plant is not at its ultimate when the worker has been geared up to the last mechanized planning of motions. There is a wealth of opportunity for improved co-ordination of shop with executive offices through control of the drafting room and accounting department for flexible designing and intelligent forecasting of sales. One manufacturer's tale of what can be done in motor production is told in this issue.

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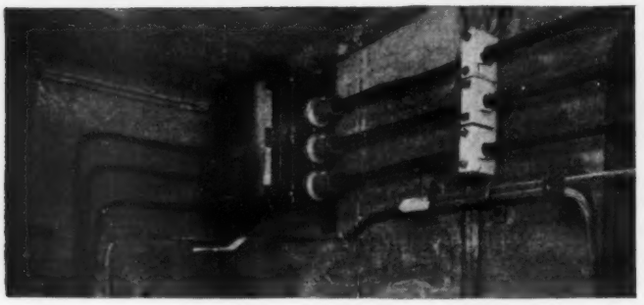

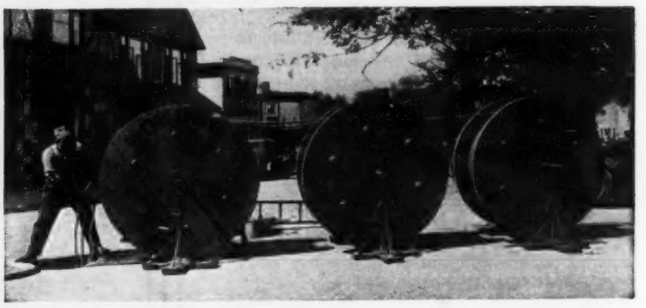

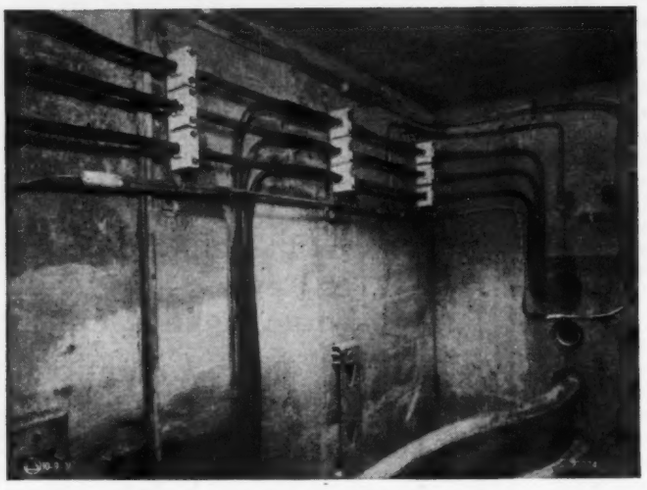

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ELECTRICAL WORLD

Established 1883—McGraw-Hill Publishing Company, Inc.

for the Week Ending

September 16, 1933

L. W. W. MORROW, *Editor*

Senseless Water-Power Development

TO WHAT pass are we heading with taxpayers' money? At Boulder Dam, in the Tennessee Valley, on the Columbia River, in the western part of Nebraska and elsewhere the United States government is pouring or preparing to pour millions of dollars into water-power projects that are economically unsound. And this is being done at a time when the auctioneer's hammer clangs in every locality in the sale of tax-delinquent property. Why do not the engineers tell the facts to the government and to the public?

Forget the political aspects and the animosities aroused by opinions about private or government ownership and present the issue on a fair balance sheet basis. Look at water-power development and see it clearly. Find out what fuel-burning power is produced for in Los Angeles and contrast this cost with that estimated for Boulder Dam power? Go down into the coal fields of Alabama and Tennessee and find out what may be done in fuel-burning stations today. This is the way of common sense. This is the method used by the engineer.

The generation of electricity from water power is a fully developed art today, with an efficiency of transformation from falling water to electricity in the order of 95 per cent. Future developments cannot hope to better these results appreciably. On the other hand, modern steam plants have an efficiency of only 30 per cent, with a future possibility of 90 per cent under controlled conditions of time incidence for heat and power outputs. Also, new technology and factory-built assemblies are available to reduce greatly both the first cost and operating costs of fuel-burning stations. Even fuel stations five years old are obsolete today. Thus water power is perfected and fuel power is just approaching a stage that will cut costs enormously. These are the fundamental facts.

But let us go further. To the cost differential that already favors fuel stations we must add another burden of water power. This is the cost of long-distance transmission lines and substations. For large water powers are distant from loads and the true cost of power is delivered cost. Transmission lines and substations are expensive and add to service hazards.

Privately owned utilities have already found that they overdid water power and transmission construction. They have turned from the mammoth station and the transmission line to multiple stations at load centers with transmission as diversity and emergency tie lies. Many systems find themselves burdened with a hydro and transmission investment that is breaking their backs. They are very sorry they made the investments—many were splendid financing projects and few were sound engineering projects. In many localities business is being lost and competition is increasing because fuel-burning stations at loads can produce power at less expense than it can be supplied from

these large hydro transmission systems. Small fuel-burning stations have proved their case.

Engineers of utility systems and of power equipment manufacturers know these facts. But they keep silent. Is this because of an executive policy to protect the *status quo* and their desire to hold their jobs? Is there any public interest to be gained by getting the government in the same jam that private utilities have encountered? Or is it the nature of engineers to be non-aggressive and permit these types of developments to occur because aggressive personalities who *think* they know sponsor the projects? At all events, the engineers are keeping silent today, as they did in the past, and the uneconomical expenditures are being made.

Water-power projects of the type outlined are not worthy. They should not receive taxpayers' money because they are economically obsolete before they are constructed. To stop these senseless programs engineers who know the facts should speak out. They will not be consulted by those who sponsor the projects, but they would be heard by the taxpaying public if they would cite facts. Why not seize this public service opportunity?

Arc-melted soil proposed as road pavement

Soil heating for plant growth and soil sterilization by electrical means are familiar processes, but soil melting is a startlingly new proposal. It is proposed to melt by an electric arc whatever soil exists along a roadway and use the fused product as a "metaled" surface for the improved roadway. Just this has been suggested by N. V. Bouroff as reported in the British *Russian Gazette*. The Zudortrans scientific investigating institute is now making practical experiments with his machine which plows up clay, loam, sand or gravel, melts it and pours out behind it a 20-centimeter layer of glossy polished deposit.

If such a process proves to have economic merit it may well mean revolutionizing the construction of highways. Transport of raw materials to and from cement mills, seasonal restriction of operations, electric energy consumption might undergo profound changes if the new process is successful. It is not readily conceivable that it would require less heat energy than is now required for roasting rock to make cement and electric energy to crush it and the stone required for the concrete mix. Nor is it conceivable that the surface can easily be laid as smooth as is prescribed for the better highways. Nevertheless, along with the Australian effort to bake existing soil surfaces in place into brick roadways, it will warrant watching as a possible load of the future for utilities, so many of which have large capacity power lines along the highway routes.

Pennsylvania points the way

State and regional utility conventions are needed in this period as never before. The omission of these conventions this fall in many sections was a mistake. The recent Pennsylvania Electric Association meeting affords evidence of this fact as well as presenting a model for convention programs under present conditions. Chief utility executives in the state stated conditions frankly and constructively, the chairman of the state commission outlined policies and problems, outside speakers, notably W. C. Mullendore and Philip Cabot, presented national topics pertinent to the utility business and paramount industry opportunities such as domestic and industrial sales were treated and discussed. This meeting was a forum that informed and stimulated those in attendance.

Now as never before the rank and file of the industry need this type of convention. A frank and open discussion leads to faith and courage and rebuilds morale that ebbs through lack of information and contact with others in the industry. Under present conditions these local meetings and accompanying local committee activities are essential also to afford the groundwork for the re-establishment of national organized efforts to aid the industry. The Pennsylvania association is to be congratulated for its splendid example of courage and confidence under trying conditions.

THE WEEK

Frank Discussion at Pennsylvania Meeting

COMMENT of observers at the convention of the Pennsylvania Electric Association, September 6 to 8, was unanimous that the meeting was one of the best held in the industry. Major topics were discussed with great frankness both by industry speakers and by those from the outside.

At the opening meeting C. J. Goodnough, chairman of the Pennsylvania Public Service Commission, struck the note that dominated the meeting. He said that things are not at all right and the situation must be faced. Present conditions have no historic parallel and it is difficult to chart the future. He contended, however, that standards could be set up that would avoid the disasters of the past years. He said the public responded to truth telling and courage in high places and that it was the duty of leadership to lead and not fear an adverse reaction from the public.

Regulation of utilities, in his opinion, is still in its experimental stages as a compromise and must yet prove its effectiveness. It must not be perfunctory, but must measure up to the necessities of present conditions. Utility leaders must help in arriving at the desired end. Their co-operation and aid will be welcomed and used by commissions, but evasion and defiance will not be countenanced.

H. P. Liversidge and L. W. W. Morrow discussed the problem of selling more load, with especial reference to the home. Mr. Liversidge stressed the need for a new type of salesman and of sales effort that considered customer psychology as well as business. Mr. Morrow treated of the business organization to get the domestic load. He urged cooperative local effort, the training of sales people and the creation of consumer demand as first principles in obtaining more sales. F. A. Hegner and W. I. Bickford discussed domestic sales from the point of view of wholesalers and retailers.

W. C. Mullendore gave a splendid address on taxation. He cited figures, pointed out the discriminatory taxes placed on utilities and said that now the government even uses the taxes collected from utilities to build competitive governmental utility projects. He advocated an industry-wide effort to tell the public the facts.

Dr. Raymond Moley, ex-"Brain Trust," was supposed to speak about utilities, but instead discussed the new deal in general terms. He said we were started on a new road and could not stop. Prof. Philip Cabot took issue with Dr. Moley. In his opinion the NRA and agricultural acts were necessary as temporary measures. He lamented, however, the present trend to make the emergency measures a permanent policy and called for action by industry to make plans to replace the "new deal" with a sounder form of the "old deal." Professor Cabot stressed the fact that the states were bound to lose tax income from utilities if the government went into the power business on a large scale and the growth of government power projects would get a most positive reaction from the states because of these losses in tax income. In the opinion of this authority the indefinite nature of the future, especially of the value of the dollar, made it impossible for capital investments to be made freely and with any promise of measurable future returns.

Industrial load building was the topic of a fine paper by H. C. Thuerk. He outlined the new conditions to be faced, stressed the necessity for a higher grade and better trained power sales staff and pointed out fallacies in past endeavors to sell. J. F. Gaskill, Francis McQuillin and F. W. Shackelford discussed several aspects of industrial selling.

Two outstanding addresses were given by F. R. Phillips, president of the Philadelphia Company, and W. S. Finlay, Jr., president of the West Penn Electric Company. These executives talked frankly about conditions faced by the utilities. They were confident that present problems could be solved and

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The Second Line of Defense

Wide World

Successful in defeating the efforts of Cook County authority, with federal backing, to secure his extradition from Hellenic haven some months ago, Samuel Insull faced a second attempt by the U.S. government to insure his return to Chicago early this month (ELECTRICAL WORLD, September 2, page 295, and September 9, page 325). With his Greek counsel he heard the court uphold his detention pending a full restatement of the case.

called for the support and undivided loyalty of all electrical men in their solution. They urged aggressive action to get fair treatment of utilities as regards taxation, competition, rates and public relations. They were confident that the industry would go forward and that present conditions were temporary.

Problems of market development

"Developing the domestic business means marketing satisfaction to millions," H. P. Liversidge told the delegates. "The problem — or problems, rather—seem to be, first, a customer-relations problem, then a sales problem, and lastly, an engineering problem.

"To put it simply, the domestic market depends first of all upon creating a better feeling between the domestic customer and ourselves. Therefore, we must ask: What do our present customers think of us and our service? What is the nature of the sales resistance to our program of selling them more kilowatt-hours? What must be the character and intensity of our efforts to offset the constant bombardment of antagonists and critics of our industry whose statements are directed to the undermining of public opinion and public confidence — building up sales resistance, if you please?

"Upon the answer to these questions our initial success in greater domestic market-building depends. In fact, it is not too much to say that upon the answer may depend the future status of our entire industry."

Cabot arraigns new deal

Charging the National Recovery Administration with using Ku Klux tactics in enforcing its codes, Professor Cabot of the Harvard School of Business Administration and former utility executive declared the federal government to be one of the worst "chiselers" against the NRA because it permitted the "unfair competition" of Muscle Shoals, Boulder Dam and other publicly financed electric developments.

"As an emergency measure the recovery program was necessary and wise," he said. "But if we allow ourselves to be lulled to sleep by addresses of the President about the New Deal and appeals for co-operation by the National Recovery Administrator, we may wake up some morning in a new world.

"Unless we are prepared to abandon the forms of government under which we have lived, we must see to it that this situation is terminated at the earliest possible moment."

H. B. Bryans, vice-president of the Philadelphia Electric Company, was elected president of the association.

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T.V.A. as a $106,000,000 Yardstick

More than $56,000,000 has been assigned for use in the Tennessee River Basin by agencies of the federal government in addition to the $50,000,000 allotted to the Tennessee Valley Authority, according to a report issued last week by Kendall K. Hoyt of the Authority.

T.V.A. rates announced

David E. Lilienthal, member of the board of directors of the Tennessee Valley Authority, this week made the following announcement:

Any municipality, in the area we plan to serve initially, which owns its distribution system, assuming half-time use, may secure wholesale power from the Authority at an average cost to it of 7 mills a kilowatt-hour. We propose that our municipal wholesale customers charge the individual residence consumer in the towns and cities thus served a maximum gross rate of 3 cents a kilowatt-hour for the first block, and for subsequent blocks 2 cents, 1 cent and 4 mills. For the typical general consumer this is an average of about 2 cents a kilowatt-hour, and for the typical limited user an average of about 2¾ cents. For a fully electrified home—which is our objective—the rate would average 7 mills per kilowatt-hour.

The farm user, we propose, should pay the same rate for energy as the town and city householder. These schedules, both for town and farm, carry with them a requirement that the customer use a reasonable amount per month as a minimum. These minimum requirements vary, both in urban and farm territory, with the size of the customer's meter. Farm users will have a larger minimum requirement wherever the greater distances between customers result in increased costs of service.

These wholesale rates have been computed on a conservative basis to cover all the costs of furnishing the service, including operation, maintenance, depreciation and taxes. In addition to these costs, we have made provision for interest and retirement, although such provision is not required by the Tennessee Valley Authority act. The power project is designed to be strictly self-supporting and self-liquidating.

We believe that these low rates will mean that the people of the valley will greatly increase their use of electricity, which is one of the objectives of the President and Congress. If this occurs, even lower rates can be planned for the future.

The proposed rates to the householder and farmer should be explained in more detail. Under the rate for domestic service, it is proposed that for the first 50 kw.-hr. which the householder uses he shall pay 3 cents a kilowatt-hour. These 50 kw.-hr., in the ordinary small or medium-sized house, would care for the lights and small electrical appliances, such as the flat iron, toaster, percolator, vacuum sweeper, washing machine, and similar small devices. For these 50 kw.-hr. the user would pay $1.50. If the consumer has an electric refrigerator and an electric range which together consume 200 kw.-hr., 150 of these kilowatt-hours per month he would get for 2 cents per kilowatt-hour, and the remaining 50 kw.-hr. at 1 cent. If in addition to an electric refrigerator and range the customer had an electric hot water heater, this service he could secure partly for 1 cent per kilowatt-hour, and partly for 4 mills per kilowatt-hour. All these services the consumer would receive for $6.70 a month. Any other appliances which the customer installed, such as electrical house heating or cooling, he could operate at 4 mills per kilowatt-hour.

It is apparent that the rates proposed are designed to encourage and make possible the widest use of electric service, with all the individual and community benefits which go with such wide use.

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New York Accounting Plan Opposed by Utilities

Protesting that "the proposed systems contain provisions which have been shown by competent witnesses to be impracticable, unworkable and not fitted to either the practical conditions of the utility business of these companies, or to the way in which capital expenditures are made, measured and controlled by them," the local New York City electric utility companies have filed memorandum objections to the new accounting rules which the state regulatory body seeks to impose (ELECTRICAL WORLD, May 13, page 600, and July 22, page 99).

The memorandum further states: "They would introduce a highly elaborate and complicated system of detail property cost recording with endless requirements for arbitrary allocation of costs between items of property, in the place of the comparatively simple systems now used which have proved their workability and essential accuracy."

Installation of a proposed perpetual inventory and depreciation accounting would cost all the gas and electric companies of the state approximately $21,000,000 a year; and the cost of annual maintenance would be $3,000,000.

"An order by the commission attempting to impose on the companies the proposed amended uniform system of accounts would go far beyond any action heretofore taken by the commission with respect to accounting practices by public utilities and would be beyond the power of the commission to make, under existing provisions of the law," the memorandum contends.

"The fundamental objection to such an order," it continues, "which clearly places it beyond the power and jurisdiction of the commission, is that, in addition to prescribing methods of keeping accounts and records, it would be an attempt to prescribe certain acts and practices to be entered in the accounts and records.

"Accounts are merely a record of certain things that are done; and power to regulate the method of keeping the

record, in the interest of accuracy, clarity and uniformity, cannot be stretched to include a power to direct the performance of the acts themselves."

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Air-Conditioning Engineer Sees Closed-Window Age

Not the dull monotony of windowless homes, but the compromise of windows that never open, is the goal seen by Elliott Harrington, General Electric air-conditioning engineer, for future domiciling of American families.

"It is quite true," states Mr. Harrington, "that we air-conditioning people do not want to have the outside air promiscuously admitted through open windows. We allow it to enter only through intake ducts and through filters which cleanse it, and we then pass it through apparatus that puts it in proper condition as to temperature and humidity before we permit it to come into the presence of human beings. Such a procedure demands closed windows at all hours and all seasons.

"Let the windows remain, but seal them hermetically into the walls. Let them be made in a single sash. Thus we can eliminate those troublesome cracks which now characterize windows of the prevalent type. Windows which will never be opened need have no cracks around the sashes. By the same token they may consist of the double-sash type.

"Better still, the full effect of double sash can be obtained with double glass set into a single sash, with a saving in first cost and a more sightly appearance. This double glass might be hermetically sealed around the edges in such a manner as to permit of expansion caused by temperature changes. A drying agent would be used to prevent 'frosting' between the two glass panes."

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Atom-Energy Utilization Far Off, Scientists Hear

"Any one who says that with the means at present at our disposal and with our present knowledge we can utilize atomic energy is talking moonshine," Lord Rutherford, head of the Cavendish Laboratory, Nobel prize winner and pioneer physicist in atomic research, told the British Association for the Advancement of Science, meeting in Leicester, England, this week.

Those at the meeting heard a number of reports on atomic energy research, but Lord Rutherford quieted wild hopes that early results might be anticipated from any of the dozen or more atom-smashing laboratories now engaged in the problem. It is his contention that the problem of the atom is the problem of the nucleus and that the large-scale experiments under way, while impotent to effect definite results in the release of atomic energy, are invaluable in the derivation of fundamental knowledge which must precede controlled disintegration of matter.

Rumors Complicate Uncertainty

Conflicting influences, derived from uncertainties, leave the business situation far from clear. Labor Day upset the figures of the week. Inflation-yes, inflation-no rumors left markets floundering. Failure to complete the major codification movement, with Henry Ford and the bituminous coal industry offering examples of conscientiously protesting recalcitrants, has stirred other less courageous protestants.

Most recent figures (on the up side) show carloadings for the week before Labor Day at the high point of the year and 5 per cent over the previous week; bituminous coal production up sharply to nearly 50 per cent over 1932 and somewhat above 1931, and commodity prices at little below the July peck. Most recent figures (on the down side) show automobile production continuing its several weeks drop; energy production off about as much as might be expected due to the holiday; steel production declining further, and general indexes off again.

Out of such conflicting grist the speculative markets ground a temporary spurt which carried securities and commodities further up. Recurrent rumors of inflation were credited with some influence in this short-lived movement.

Alert observers of retail trade report considerable resistance to price increases and manufacturers revive their interest in lower-priced lines which will absorb otherwise-reluctant purchasing power. Wider use of government credit and greatly augmented purchases of federal bonds by the Federal Reserve banks, now at the rate of $38,000,000 a week, bringing the holdings of the system to a record $650,000,000, offer an exceedingly real inflation, quite different from currency manipulation.

More Sodium Lighting

Sodium vapor lighting is relied upon for the illumination of the new vehicular tunnel under the Scheldt River in Belgium. King Albert opened the project for use this week.

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Rocky Mountain Group Meets

Commercial possibilities, campaign plans, fields for specific loads, etc., strongly dominated the three-day convention of the newly formed Rocky Mountain Electrical Association this week. Lighting, both commercial and domestic, air conditioning, power sales and competing agencies will be a field of active effort in Wyoming, Colorado and New Mexico in the coming months if the convention program offers a fair guide. The association's all-industry drive is to be pushed further (ELECTRICAL WORLD, May 27, page 657).

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Airway Lighting Resumed

Resumption of full-time lighting along the three principal transcontinental airway routes and on the West Coast route from Seattle to Los Angeles has been ordered by Secretary Roper. Protests from many sections of the country that safety of life was being menaced followed the reduction last March in the hours that lights were maintained on the airways. It is estimated that full-time lighting means added expense for the balance of the year of $120,000.

Eastern Insull Plan Expedited by Foreclosure

As a step preparatory to the reorganization of Northeastern Public Service Company, part of the group of former Insull properties in the East, the City Farmers Trust Company has started foreclosure action as trustee for the company's first lien collateral trust bonds, of which there are $4,670,500 outstanding. Bill of complaint was filed last week in the Chancery Court of Newcastle County, Delaware, against the company and Walter G. Mortland and Clarence A. Southerland, receivers. Northeastern Public Service controls 58 small utility operating companies, principally serving communities in New England and in Eastern states. These properties were bought by the Insull interests at an auction in June, 1931. They had been in the Atlantic Public Utilities system, then controlled by the late A. E. Fitkin.

More than $30,000,000, or 75 per cent, of the outstanding Middle West Utilities Company serial gold notes are now deposited with the noteholders' committee of which Charles S. Dewey is chairman. Representing this substantial total, the noteholders' committee is by far the largest creditor of the company and will be the principal factor in its reorganization. The committee is now preparing a report for distribution shortly to all depositors.

A recent statement issued in Chicago places the amount of claims filed by unsecured creditors of the Insull Utility Investments, Inc., in excess of $56,000,000, practically all of which consist of A and B debentures, comparing with unpledged tangible assets of $2,500,000. Leo F. Wormser, attorney for Harry A. Bigelow, trustee in bankruptcy, stated that the amount applicable to each $1,000 debenture cannot yet be closely stated.

Coming Meetings

National Electrical Exposition—New York, N. Y., September 20-30. Ralph Neumuller, 480 Lexington Ave., New York.

American Welding Society—Detroit, Mich., October 2-6. M. M. Kelly, 29 West 39th St., New York.

National Safety Congress, Public utilities section—Chicago, Ill., October 2-6. C. B. Boulet, Wisconsin Public Service Corporation, Milwaukee, Wis.

National Association of Railroad and Utilities Commissioners — Cincinnati, Ohio, October 10-13. James B. Walker, 270 Madison Ave., New York.

Association of Iron and Steel Electrical Engineers—Pittsburgh, Pa., October 17-19. John F. Kelly, Empire Building, Pittsburgh.

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New York Tax Program Protested by Utilities

At a hearing before the Board of Aldermen branch of the New York Municipal Assembly early this week public utilities protested the new temporary tax of 1½ per cent on their gross income, embodied in the proposed city tax program, as unfair. The report submitted to the Assembly recommended a tax "upon the gross income from operations and transactions originating and consummated within the city of New York, with the residents thereof, of all the public utility corporations operating within such city. This tax should be payable on the first day of each month during the aforesaid term, the proceeds to be likewise applied toward home and unemployment relief, as provided by the aforesaid law. This tax is expected to yield approximately $8,300,000." The temporary legislation in which the utility tax is included will extend from September 1 of this year to February 28 of the coming year.

The measure provides also that the books and records of the companies must be open to the Comptroller, and he receives power to hold hearings, subpœna witnesses and books and ask the Corporation Counsel to start suit if the companies fail to make payments. It also provides for a penalty of 1 per cent per month for each month that it is delayed. The Comptroller is also authorized to swear out warrants to attach the property of the companies to satisfy tax judgments obtained in the courts, and is ordered to keep the returns secret, except for use in court proceedings. Despite the vigorous protests the Board of Estimate voted approval of the new tax.

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Passamaquoddy Again

Inspired by the possibilities of federal aid for the proposed tidal power project on Passamaquoddy Bay, Maine, advocates of the measure resurveyed the plan with George Otis Smith of the Federal Power Commission. Sponsors say the development could be financed with approximately $100,000,000 from the $3,300,000,000 public works fund and would provide work for several thousand men over a period of three years.

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Electrochemists Discuss Corrosion, New Processes

Although the general public has become acquainted with the term "rustproof iron" and "stainless steel" and accepts chromium, cadmium and other plating as insurance against corrosion, this matter is not yet by any means a closed subject technically, as was evidenced in the opening session of the Electrochemical Society in Chicago last week. This session was an international symposium on corrosion, with papers from Great Britain, France, Germany, Holland, Czechoslovakia and the United States. The papers brought out that fundamental progress has been made both in the development of new corrosion resistant steels and, of equal importance, in the methods and means of protecting ordinary carbon steel. However, the papers gave emphasis to the facts that the mere presence of copper or chromium in steel does not insure against corrosion and that the mere painting of steel is not a guarantee against rust. It is how these alloying metals are present in the steel, in what proportions and combinations, and how and what kind of paint is applied to the steel surface that determines resistance to and protection from corrosion.

Thirty years ago Dr. W. R. Whitney announced the corrosion of metals to be an electrochemical phenomenon. The anniversary of this announcement furnished a peculiarly suitable occasion for opinions, results of study and experimentation in the subject to be brought together in a single paper. This was done for presentation at the convention by Oliver P. Watts, under the title of "The Electrochemical Theory of Corrosion." For those engineers and others whose work requires that corrosion of metals be taken into account but who are not intimately acquainted with the science of electrochemistry this paper should be of great interest. The paper brings together statements of opinion from eleven authorities on corrosion in England and the United States, and these opinions are accompanied by an excellent detail summary of the general theory by the author.

On the evening of the first day occurred the ceremony of presentation of the Edward Goodrich Acheson medal to Dr. Colin G. Fink. Accompanying the medal was a money award of $1,000, which Dr. Fink announced as the first contribution toward a fund for research in electrochemistry to be known as the Roeber Fund as a memorial to Dr. Eugene F. Roeber, one of the founders of the society and the first editor of the magazine *Chemical and Metallurgical Engineering*. On another evening the Faraday Centennial celebration was held, at which the guest of honor, Dr. Robert F. Hutton, Cambridge, England, spoke on "Faraday and His Electrochemical Researches." Much of the interest of the convention centered on the World's Fair, particularly the Hall of Science and the Electrical and Communications buildings, where numerous special demonstrations and lectures were staged for the convention attendants.

Sessions on Friday covered new methods and improvements in old ones in the electrodeposition of various metals, and reports were made upon factors and variants affecting the successful use of the process.

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Industry Codes Languish; No New Hearing Dates Set

Electrical industry codes remain in little changed status as another week rolls by. Of the more important ones only the N.E.M.A. code for electrical manufacturers has been signed and approved by President Roosevelt. Hearings have begun on the construction industry code, but the sub-codes follow the master code and that sponsored by the National Electrical Contractors Association has yet to be acted upon.

No hearings have been scheduled for the Edison Electric Institute code for electric light and power companies, the National Electrical Wholesalers Association code, the code of the Artistic Lighting Equipment Association or that of the wood preserving industry. The National Battery Manufacturers Association has revised the document originally submitted to include "merit" clauses in the labor provisions.

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Holding Company Values Weighed by Bar Committee

Reporting as chairman of the special committee of the American Bar Association on the regulation of holding companies and of the relation between such companies and their affiliates, Henry G. Wells, member of the Massachusetts Public Utilities Commission, characterized the underlying principles of holding companies as sound at the recent annual meeting of the association. He maintained that there are many advantages derived from their existence. "Mass production and distribution," Mr. Wells stated, "resulting from unified operation, has undoubtedly resulted in lower rates being charged the public than would be possible with separate plants serving each community. Intensive research, made possible by large

organizations, has added greatly to the efficiency of service, and the availability of experts has aided local companies in problems of engineering, accounting, law and financing. Interconnection of plants has provided protection against interruption of service and has facilitated handling of load conditions. The concentration of generating facilities results in greater operating efficiency and reduced costs . . . "

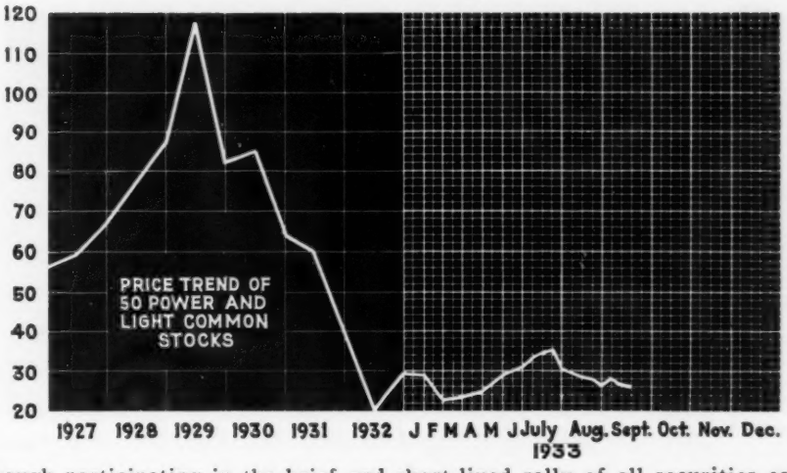
Taking up the subject of certain disadvantages of holding companies which have become manifest of late years, Mr. Wells said: "These fall into two classes. The first contains the abuses arising out of unnecessary or unreasonable payments by the operating companies for the various services referred to and the second arises out of financial transactions, such as the borrowing of substantial sums from operating companies or the requiring of excessive dividend payments by operating companies, thus impairing the financial stability and quality of service of such companies. Inadequate provisions for depreciation reserves and surpluses and insufficient expenditures for repairs and replacements have often resulted by reason of the demands of holding companies upon their subsidiaries.

Consumers indirectly affected

"While the alleged abuses in the issuance and sale of securities are foremost in the public mind, it should be remembered that the effect thereof upon the operating companies, and hence to the consumers, is only indirect, and that effect is largely a resulting pressure by the holding companies upon the operating companies through the methods pointed out. Apart from that, this problem of the sale of holding company securities is a 'Blue Sky' matter. Any procedure should be based on the theory that prevention of abuses should not at the same time hamper the companies with legitimate policies or hinder the rendering of proper services to operating companies. No undue restrictions should be placed on the sale of these securities which are not equally applicable to the sale of other securities . . . "

Mr. Wells expressed doubt as to the wisdom of further federal regulation, stating that "the state authorities would seem to have ample authority to protect the operating companies and their customers, if they choose to exercise it. . . . The only feature concerning which there seems to be some doubt is the ability of the regulatory bodies to secure information to compel the production of facts in possession of holding companies and beyond the reach of the regulatory board. . . . There is a growing tendency, however, among the various holding companies and operating companies to adopt the policy of furnishing evidence asked for by the regulatory bodies."

Utility Stocks Edge Lower



Though participating in the brief and short-lived rally of all securities early in the week, utility common stocks as covered by the "Electrical World" average dropped to 26.3, as compared with 26.9 for last week.

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Virginia Tax Doubled Under Gross Receipts Levy

Following the action of the Virginia General Assembly, in special session last week, doubling the gross receipts tax on power companies, electric railways, gas and water companies, telephone and telegraph companies, motor vehicle carriers and the Virginia Pilots' Association, the Virginia State Corporation Commission made an increased assessment at once.

The new tax increases the levy on gross receipts from one-tenth of 1 per cent to two-tenths of 1 per cent. Proceeds will be used to finance investigations of the rates charged by Virginia utilities for service to the public.

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Pledge Warrants in Iowa Law

Holding pledge warrants given by municipalities to manufacturers or contractors in interim compensation for a plant or project ultimately to be paid for out of the property itself to be included in the provisions of the Iowa securities act, Walter F. Maley, First Assistant State Attorney-General, rules that such pledges are not exempt from registration and qualification provisions of the law.

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Oklahoma Tax Voluntary

By vote of the Oklahoma Corporation Commission an order issued several weeks ago requiring electric, telephone and gas utilities of the state to absorb the 1 per cent general sales tax unless they should show inability to assume the tax and make an adequate return on their investments has been vacated. Chairman Walker advised utilities to continue absorbing the tax as a good will measure.

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California, Kentucky, Ohio Urge New Utility Taxes

No easing of the rising tide of special taxes directed at utility enterprises is in sight. Latest proposals involve three states.

Kentucky legislators are considering two bills. Representative Hamilton introduced a measure to tax electric energy sales one-fourth of a cent a kw.-hr. (gas one-half cent a thousand cu.ft.). Representative Sullivan has a proposal before the same body to levy a tax of two per cent on gross receipts of every public utility enterprise in the state (gas, electricity, telephone, telegraph and water).

California's Governor Rolph has signed a bill which gives the power of taxation on utility properties to the counties. This becomes effective with 1935 assessments. It will be in lieu of the existing state gross receipts levy.

In Ohio, Governor White proposes that since electric companies must pay the federal tax on energy sales that all other utilities be forced to pay a similar amount, assessed in the same way, to the state.

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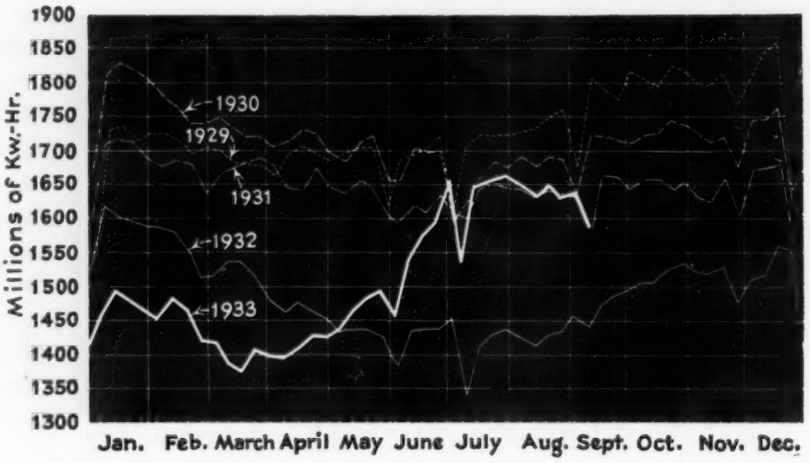
Nebraska Has Power Project

Southeastern Nebraska Power District, plans for which have been approved by the state Department of Public Works, would involve 600 miles of transmission lines for rural service to farmers unable to secure energy from existing companies.

Labor Day Brings Usual Dips



Central-station energy output, as announced by the Edison Electric Institute, fell off about 55,000,000 kw.-hr. in the week of September 9 as compared with the preceding week. The decrease was about the same as in the Labor Day week of 1931 and somewhat greater than in 1932. Total production, 1,582,742,000 kw.-hr., duplicated that in 1931.

Level operations in recent weeks, against rising production a year ago, have cut the lead over 1932 to 11.1 per cent. Strongest regional gains continue in the metal-mining Mountain and Central industrial areas.

Weekly Output, Millions of Kw.-Hr.

1933		1932		1931	
Sept. 9..	1,583	Sept. 10..	1,424	Sept. 12..	1,582
Sept. 2..	1,637	Sept. 3..	1,465	Sept. 5..	1,636
Aug. 26..	1,630	Aug. 27..	1,436	Aug. 29..	1,638
Aug. 19..	1,650	Aug. 20..	1,432	Aug. 22..	1,643
Aug. 12..	1,627	Aug. 13..	1,415	Aug. 15..	1,629

Per Cent Change from Previous Year

Region	Week ended Sept. 9	Sept. 2	Aug. 26
New England	+10.7	+12.7	+16.5
Middle Atlantic	+ 7.7	+ 6.8	+10.2
Central industrial	+16.2	+17.4	+18.2
West Central	+ 3.7	+ 1.9	+ 3.8
Southern States	+ 8.4	+ 9.9	+11.6
Rocky Mountain	+26.7	+23.1	+27.1
Pacific Coast	+ 2.6	+ 5.0	+ 5.9
United States	+11.1	+11.8	+13.5

July Output 14 per Cent Over Last Year's

Output of public utility plants in July, mounting to 7,462,903,000 kw.-hr., exceeded that of June by 3 per cent and that of last year's July by 14 per cent, according to the U. S. Geological Survey. The latter is the largest year-to-year increase since the era of rising activity in the late twenties. It compares with 10 per cent in June, 5 in May and with losses during a long preceding period.

Average daily production was 240,740,000 kw.-hr., virtually the same as in June. The normal change from June to July is a decrease of about 3.5 per cent. Water power contributed 2,825,870,000 kw.-hr., 38 per cent of the total production.

Regional gains over 1932 ran as high as 28 per cent in the South Atlantic, 25 per cent in New England, 22 in the Mountain and 21 in the East North Central Division. Every one of these was greater than in June. Only one region reported a loss, 2 per cent in the West North Central States.

The quantities reported by the survey are based on the operation of all power plants producing 10,000 kw.-hr. or more per month, and generating energy for public use, of which the output of plants for electric light and power constitutes about 94 per cent.

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American Electric Motor Company

All property and patents of the American Electric Motor Company, formerly a subsidiary of the Splitdorf-Bethlehem Electrical Company, have been acquired by the Cedarburg Manufacturing Company, which will continue to produce American-Electric motors. T. Hansen, formerly works manager of the A. O. Smith Corporation, is president and general manager.

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Spherotrain in Russia

Electrically operated, a new form of transportation lacking wheels, track or other familiar adjuncts of ground transportation was demonstrated to startled Muscovites recently. The system involves stream-lined cars which are supported on spheres which in turn run along in a flume-like channel. Models have been demonstrated at about 45 miles an hour. Advantages are said to be reduced cost, minimized vibration and greater safety. The Soviet Railroad Commissariat has authorized the construction of a 15-mile full-scale test section with spheres about 8 ft. in diameter.

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California Supreme Court Orders Riparian Retrial

Acting in the ten-year-old litigation of two California farmers against the Mt. Shasta Power Corporation over riparian rights the state Supreme Court has ordered the case back for a third retrial in the Shasta County Supreme Court.

In the second trial of the case a jury awarded $96,300 damages to Albaugh, owner of 400 acres, and $32,100 damages to Crum, owner of 116 acres. From this judgment the power company appealed.

The Supreme Court holds that the landowners are not entitled to recompense from the power company for any asserted diminution in the supply of the water in the stream, but should be given damages for the pollution of the stream, which has occurred since the power company constructed a diversion dam on the Fall River, a Pit River tributary.

In sending the case back for material, the judiciary ruled the lower court erred in not admitting into evidence a stipulation by the power company guaranteeing the natural height of the Pit River, adjacent to the land of the plaintiff owners, will be maintained. The court is of the opinion this stipulation, taken at its face value, would relieve the power company of a part of the damages.

"We are clearly of the opinion," remarked the Supreme Court, "plaintiffs are entitled to damages, if any substantial damage or diminution in the value of their lands has resulted from the diversion."

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Quick-Stopping Mill Motor

Said to be the largest device of the kind ever built for such quick-stopping service, the 1,000-hp. motor constructed by Westinghouse engineers for the Goodyear Tire & Rubber Company will come to a dead halt from full speed in 3½ revolutions. The rotating element weighs more than 3 tons and turns with a speed of 514 revolutions a minute. By stopping the driving motor in 3½ revolutions the rolls travel only 9 in. after the current is shut off. Dynamic braking is used.

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West Kootenay Opposed

Opposition to the proposal of the West Kootenay Power & Light Company of British Columbia to store water in Kootenay Lake during low water pe-

riods and to construct control works on the Kootenay River was expressed by farmers representing drainage districts of northern Idaho at the hearing before the International Joint Commission sitting at Nelson, B. C., last week. J. A. Metzger, United States water rate department, and Bert H. Miller, Attorney-General for Idaho, led the forces for the opposition. At the hearing Mr. Miller created a furor when he denied that the commission had jurisdiction to deal with the application because, he claimed, if it did so it would be encroaching on treaty-making power.

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Utility and PWA Join to Review Project Loans

Pacific Gas & Electric Company has sought and has been granted permission to appear before the regional public works adviser in all applications from its territory involving loans for public power projects. In a letter to the regional adviser, the California advisory committee and the district advisory engineer, P. M. Downing, vice-president and general manager of the company, pointed out the interest the utility had in projects which might involve its purchase of energy to be generated or which might compete with it in its present markets.

Mr. Downing declared that there has been a great decrease in the use of power in California owing to the depression, and that nearly one-fourth of the productive capacity of the power plants in the state is now idle. "Under the circumstances, this company believes that it is important to your investigation of any of the applications referred to that you have before you all of the facts as to the supply, or rather oversupply, of power in California," he said.

It was pointed out that by 1935 power for southern California would be available from Boulder Dam and that by 1938 4,300,000,000 kw.-hr. of firm power and 1,300,000,000 kw.-hr. of secondary power from Boulder Dam would be thrown on the southern California market. Power from plants in the San Joaquin Valley, which now supply the southern part of the state, would be diverted to the central and northern market in competition with present supplies.

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More Boulder Line Contracts

Contracts have been placed by the Los Angeles, Calif., Board of Water and Power Commissioners with the Graybar Electric Company, Ltd., and the Anaconda Wire & Cable Company of California for 1,256,000 lb. of ¼-in. rolled black copper rods. The contract price was $146,010. The rods will be used as ground counterpoise in the 271-mile Boulder Dam power transmission line now being constructed by the city of Los Angeles.

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New York Metal Prices

	Sept. 5, 1933 Cents per Pound	Sept. 12, 1933 Cents per Pound
Copper, electrolytic	9.00	9.00
Lead, Am. S. & R. price	4.50	4.50
Antimony	6.875	6.75
Nickel ingot	35.00	35.00
Zinc, spot	5.07	5.02
Tin, Straits	45.625	45.125
Aluminum, 99 per cent	23.30	23.30

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Grand Coulee Authorized by Power Commission

Authorization of a permit for the Grand Coulee project on the Columbia River in Washington has been made by the Federal Power Commission to the Columbia Basin Commission. This action gives to the Columbia Basin Commission priority for a period of three years in applying for a license which would authorize actual construction work.

The project contemplates a dam across the Columbia River 600 miles above its mouth, with an electrical generating capacity of approximately 700,000 hp. Plans contemplate increasing the height at a later date to bring the horsepower capacity to approximately 2,100,000.

The release of federal funds to aid this project was made some time ago (ELECTRICAL WORLD, August 5, page 162).

Grand Coulee work started

Field work for preliminary surveys of the Grand Coulee Dam project in north central Washington have been started under Frank A. Banks, engineer of the federal reclamation service, in charge of field surveys with a staff of 37 engineers in seven crews. The field office has been established at Almira, Wash. Bids on core drilling, test pit digging and open trench work were opened here last week at a meeting of the Columbia Basin commission.

Major New Construction This Week

Machine drives, motors, controls, regulators, conveyors and other equipment will be installed by M. & M. Woodworking Company, Portland, Ore., at cost of about $100,000.

Appropriation of $150,000 has been authorized for extensions and improvements in power plant at Mare Island, Calif., Navy Yard. Appropriations also made, for extensions and improvements in power plant at Washington, D. C., Navy Yard, to cost $325,000.

St. Peter, Minn., plans city-owned electric light and power plant to cost $225,000 with equipment, and is arranging fund.

Until September 25, Alexandria, Minn., asks bids for turbo-generator and complete accessory equipment, for city-owned electric light and power plant.

Wurzberger Beverages, Inc., Dallas, Tex., plans brewery and power house. Cost about $250,000.

Bureau of Yards and Docks, Navy Department, Washington, D. C., asks bids, until September 27, for condenser and auxiliary equipment, navy yard, New York (specification 7231); until October 4, for one 1,500-kw. and one 500-kw. turbo-alternators with accessories for Naval Academy, Annapolis, Md. (specification 7414); until October 11, for electrical distribution system, including cables, transformers, primary cutouts and accessories, for Naval Air Station, Corry Field, Pensacola, Fla. (specification 7408).

Pilsner Brewing Company, Seattle, Wash., plans plant at Portland, Ore., including power house. Cost $300,000.

Until September 27, Los Angeles, Calif., asks bids for two complete carrier current protective relaying equipment for double circuit 132,000-volt transmission lines, including coupling capacitors and potential devices.

Radford, Va., has secured federal permission for city-owned hydro-electric generating plant on Little River, including transmission line to city. Fund of $129,000 being arranged.

Bids being received until October 2 by United States Engineer Office, Huntington, W. Va., for construction of power house, twin locks, with operating gates and machinery, on Kanawha River, near Winfield, W. Va.

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Delinquent Electrical Accounts

(National Electrical Credit Association)

Number of Accounts Reported

Division	August 1932	August 1933	Per Cent Inc. or Dec.	Eight Months 1932	Eight Months 1933	Per Cent Inc. or Dec.
New York	269	135	— 49.8	1,967	1,222	— 37.9
Middle and Southern Atlantic	105	41	— 70.0	900	431	— 52.1
New England	139	36	— 74.1	845	476	— 43.7
Central	389	167	— 57.0	3,752	2,035	— 45.8
Total	902	379	— 58.0	7,464	4,164	— 44.2

Total Amounts Reported

New York	$18,663	$8,751	— 53.1	$176,398	$82,216	— 53.4
Middle and Southern Atlantic	9,862	2,060	— 79.1	82,660	24,526	— 70.3
New England	8,526	1,268	— 85.1	66,368	27,864	— 58.0
Central	23,045	7,639	— 66.9	273,302	120,099	— 56.1
Total	$60,096	$19,718	— 67.2	$598,728	$254,705	— 57.5

As to Rates——

• Philadelphia Electric Company won a decision against the Public Service Commission last week when the Dauphin County Court ordered the commission to show cause why the court should not restrain that body from forcing the company to justify its new rates (ELECTRICAL WORLD, August 12, page 200). The return date on the ruling remains to be set, but it was indicated it will be returnable during the week of October 23. September 23 had been set for a hearing on the rates, which were to have gone into effect January 30, and which the company says would decrease its gross revenue by approximately $1,800,000 annually. However, company officials say, discontinuance of free lamp exchange would save about $900,000, leaving the net reduction in gross revenue at $900,000 to $1,000,000. Frank M. Hunter, counsel for the company, asks that Comptroller Wilson of Philadelphia, who has brought three complaints against the new rates, be required to bear the burden of proof that the rates are unreasonable, rather than that the company must prove that the tariffs are reasonable.

• California Railroad Commission has declared that it does not propose to be "stampeded" into granting blanket increases in rates to utilities joining the NRA and seeking at the same time to place a burden of higher labor and other costs on consumers.

• Puget Sound Power & Light Company, Pacific Power & Light Company and the Washington Water Power Company have filed separate appeals with the Thurston County Court from the recent state Department of Public Works order granting 10 to 35 per cent irrigation and spray power rate reductions (ELECTRICAL WORLD, August 19, page 233). "Our company, during the last two years," Frank T. Post, president of the Washington Water Power Company, said, "has gone to great lengths in furnishing financial assistance to the irrigators using electric power . . . In quite a few instances the irrigator owed all or a part of his 1932 power bill, and those bills were not pressed, but extended until after the marketing of the 1933 crop. Not a single person in possession of land under deed, contract or lease failed to get electric power in 1933 if he asked for it . . ." Superior Judge John M. Wilson denied the companies supersedeas bonds pending their appeal from the order. If the bonds had been granted the reductions would have been nullified until the cases were finally decided, probably some time next spring in the state Supreme Court.

• Utah Power & Light Company under a reduced schedule of rates will supply electricity direct to state institutions according to arrangements made at a meeting of the state board of examiners with the heads of the various institutions. The plan contemplates partial abandonment of the state power plant, at Logan. Under the old arrangement power from the state plant in that city was transmitted to institutions throughout the state over the lines of the Utah Power & Light Company, the state paying for this service.

• Jersey Central Power & Light Company's consumers in Lakewood have brought charges of discriminatory rates against the company before state Public Utility Commissioners, claiming electric and gas rates to be based upon the valuation of system holdings of the company instead of on the Lakewood plant. The United States Senate committee on banking and currency, with Ferdinand Pecora as counsel, will take an active part in the investigation, it is stated.

• Lively exchanges over points of contention greeted the hearing last week before the New York Public Service Commission in connection with the rate reductions ordered for the seven subsidiaries of the Consolidated Gas Company operating in New York City (ELECTRICAL WORLD, August 26, page 259). Floyd L. Carlisle, chairman of the board of Consolidated Gas, told Chairman Maltbie of the commission that the companies will add 2,100 employees to their payrolls at an annual cost of $3,495,000. Adding to that the approximate $1,300,000 which the spirit of NRA compliance means restoring to 10,951 whose wages were cut last year and including other similar charges, the direct estimated cost of NRA compliance was set by Mr. Carlisle at $4,859,000. Evidence was also introduced to indicate that 45 frequently used items in utility purchasing have increased 29.6 per cent since in, roughly, a year.

"By reducing rates as you propose," said Mr. Carlisle, "you will make it impossible for these companies to comply with the agreement and to co-operate in increasing employment and wages.

"The population of New York City increases on an average of 200,000 annually and wages $40,000,000 annually. In my judgment, since we must constantly meet the increase in size of the city of New York, the rate you gentlemen have fixed as temporary is far from fair. I say it would hold up the development of the city."

"Do you mean to say that with $200,000,000 in surplus and reserves, you cannot afford to give up $9,000,000 of it in a rate reduction?" asked Chairman Maltbie.

"Our stockholders have poured money back into the companies," responded Mr. Carlisle. "They have let earnings accumulate and let them become plant and underground structures and equipment. If they had known in advance about this, they would have collected dividends and there would not be a surplus."

• Alabama Power Company is faced with a loss in revenue of $825,000 annually through rate reductions and additional expenses, states President Thomas W. Martin, who has indicated that it may be forced to seek some readjustment unless increased business makes up the probable losses. "Material reductions for residential and cotton gin rates ordered by the Public Service Commission substantially affects the income of Alabama Power Company," Mr. Martin says. "In addition to $414,000 loss of revenue, the company is confronted with $144,000 immediate expense required to absorb the 3 per cent federal electricity tax paid prior to September 1 by the consumer. Thus the effect of the commission's order (ELECTRICAL WORLD, September 9, page 325) is to reduce the electric bills of our customers $558,000. To this burden on the company must be added $176,000 to comply with the government's NRA program and $91,000 for the emergency federal capital stock tax. We are unable at this time to estimate payments under the state's income tax law. The company is confronted, therefore, with $144,000 immediate loss in revenue and $411,000 additional expense, a total of $825,000.

"The public is perhaps unaware that the Alabama Power Company will this year be required to contribute over $2,100,000 in the form of taxes for maintaining municipal, county, state and federal governmental institutions. The operating costs of the company which are within its control have been materially reduced, but the total operat-

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I have a theory that a public demand, long and tenaciously held, is probably well founded, even if equities have to be impaired, or temporarily abandoned, in meeting it.

We will not earn a "fair rate" under the new schedule until we build up more business and recover the ground given away, and more, too.

We think the federal government is doing its utmost to make business better. We are making a bet, a great big bet, if you please, that it is going to.

And there is this also: I think we are on the verge of space cooling and air conditioning development that is apt to make anything else in this business look like 20 cents. We are attempting to open it to the home as well as the office and factory.

LOUIS H. EGAN,
President
Union Electric Light
& Power Company.

Mr. Egan, whose company recently made a voluntary $1,600,000 rate reduction and is now said to offer the lowest domestic energy rate from private enterprise in the United States ("Electrical World," September 2, page 298), is skeptical of "guaranteed returns," stating: "The sort of guaranty the utilities have means nothing unless you earn it. Look at the street car systems."

ing expenses have not materially come down, due largely to constantly increasing tax assessments, both state and federal.

"We hope that with substantial improvement in electric consumption, due to better times and lower rates, the expectation that the loss in revenue will be made up through greater uses of appliances in the home will be fully realized. Otherwise the company will be forced to seek readjustments. The one serious threat overhanging the company is competition with agencies free of the necessity to earn a return on invested capital and of the duty to contribute to the expense of state, local and federal governments and maintenance of educational institutions."

• East Missouri Power Company has been ordered by the state Public Service Commission to file before October 10 a new schedule of rates reducing the return to 7 per cent of the company's valuation as fixed by the commission. An application for rehearing was denied.

• Detroit Edison Company, ordered by the Michigan Public Utilties Commission to reduce rates by $1,500,000 (ELECTRICAL WORLD, August 26, page 264), and agreeing to do so (September 2, page 298), has filed with the commission new schedules affecting 50,000 small commercial consumers. The new rates represent reductions of more than 10 per cent to 30,000 commercial customers and less than 10 per cent 20,000 others.

"Our best guess," the company states, "is that when this change has general acceptance, and if business conditions improve (and in making this revision we are gambling that they will improve), then after a year's time we will find that this rate change has cost us about $800,000."

The company states that the revision will be followed shortly by another and possibly a third.

• Missouri Public Service Commission has ordered Kansas City Power & Light Company to place in effect within 30 days sliding scale penalty charges on delinquent bills. The orders call for 2 per cent on bills paid five to ten days after due, 5 per cent on bills ten to twenty days overdue and 12 per cent on those twenty or more days delinquent. This replaces a flat charge of 10 per cent on delinquency.

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Seattle to Save $342,000

Exempt from the federal tax upon electric energy sales to domestic and commercial customers, municipal plants enjoy a new economic advantage over private enterprise. Seattle, Wash., estimates that its City Light Department will be the gainer by about $342,000 a year.

Municipal Items

CHESTER, ILL. — In connection with the contemplated construction of a municipal light and power plant and distribution system, the W. A. Fuller Company, St. Louis, has been retained as consulting engineer to conduct preliminary surveys. It has been estimated that such a plant would cost approximately $150,000. It is probable the city will apply for a loan under the National Industrial Recovery Act.

HARRISBURG, ILL.—City Council has voted to issue $410,000 of 6 per cent revenue certificates to finance the construction of a municipal light and power plant and distribution system. The Council will petition the National Industrial Recovery Administration for a grant and loan. An election on the proposal will be held October 12. Russell & Axon, St. Louis, are the engineers in charge of plans.

CINCINNATI, OHIO — After a five years' discussion as to what the gas rate should be, Cincinnati may vote this fall on municipal ownership of its electric and gas utilities. Petitions asking that a municipal ownership ordinance be put to a vote were filed last week by the Gas Consumers League, which has been demanding lower rates. The ordinance submitted with the petitions would have the city condemn and acquire the gas and electric plants serving the city and operate them and would authorize the issuance of bonds necessary to finance acquisition of the systems.

OKLAHOMA CITY, OKLA.—City Council has ordered an investigation of the possibility of saving money by building a municipal power plant to pump city water and provide street lights. Tom G. Banks, water superintendent, estimated it would take $500,000 to build a power plant. The city now pays approximately $80,000 a year for street lighting and $30,000 for pumping water.

SALT LAKE CITY, UTAH — On the grounds that the issue is "too controversial for decision" by the city's elective officials, the city commission declined to act on the initiative and referendum petition for acquisition or construction of a municipal power plant (ELECTRICAL WORLD, August 5, page 169). A popular ballot on the power plant question thus becomes mandatory because of the commission's failure to act.

SAN FRANCISCO, CALIF.—Voters will be given the opportunity of approving plans for disposal of energy to be generated at the proposed Red Mountain Bar plant in the November elections as the result of action by the Board of Supervisors. The plan involves the construction of a transmission line to the city and the building and operation of a distribution system. Efforts of municipal ownership proponents to confine the voting only to the distribution project met with success when a majority of the board voted to rescind a previous action which would also have placed on the ballot a proposal to sell the output of the plant to the Pacific Gas & Electric Company (ELECTRICAL WORLD, September 2, page 297).

CLEVELAND, OHIO—Voters will be asked November 7 to approve a $2,000,000 bond issue for expansion of the municipal light plant, City Council by a vote of 18 to 7 having passed an ordinance to put the bond issue on the ballot. Although a bond issue of $2,500,000 for the same purpose was approved by a majority of the voters two years ago, it failed of passage because it did not get a 55 per cent affirmative vote.

HOMEWOOD, ALA.—Municipal ownership of a light plan has been rejected by the citizens of this independent suburb of Birmingham by the decisive vote of 328 to 146.

OAKLAND, CALIF.—East Bay Municipal Utilities District is applying for a loan of $8,500,000 from the Reconstruction Finance Corporation to construct additional power facilities to the Oakland area. The proposed project contemplates the construction of a dam and 12,000-hp. hydro-electric plant at Middlebar on the Mokelumne River, the addition of a 10,000-hp. unit to the present 20,000-hp. Pardee plant, erection of a transmission line from the plants to Oakland and the San Francisco Bay region and construction of a steam standby plant on tidewater. Estimated cost $6,500,000. The remaining $2,000,000 of the loan would be spent on the district's water system. Output of the Pardee plant is sold at wholesale rates at the station to the Pacific Gas & Electric Company at the present time. Under the new plan the district would use a part of the energy itself and sell the balance at wholesale rates to Alameda and other cities in the bay area which operate municipal systems.

WARSAW, IND., is circulating a petition asking that the City Council take such steps as are provided by statute for the condemnation and purchase of the electric property of the Northern Indiana Public Service Company. The law provides that 5 per cent of the voters at the last regular city election must sign the petition.

DEFIANCE, OHIO, City Council has passed an ordinance declaring it necessary and desirable that Defiance construct a municipal electric light and power plant and approving plans previously prepared and on file with the Service-Safety Director of the city. Application for a federal loan was entered in July.

Adequate Specifications for Rubber Insulation

By H. P. SEELYE and E. W. SPRING
Detroit Edison Company, Detroit, Mich.

ALTHOUGH rubber has been used for electrical insulation for many years, it must be recognized that no adequate specifications have as yet been generally adopted by which a purchaser may be assured of obtaining the quality of material which he desires. Early attempts to establish standards of quality resulted in specifications based on tests of the more easily determined properties of the product, such as thickness, tensile strength, elongation and dielectric strength. Later it was necessary to give attention to remedies for the rapid deterioration of insulation with age. This resulted in the introduction of restrictions on the chemical composition of rubber compound. The well-known "30 per cent Hevea" specification was quite generally adopted for high-quality insulation. This specification, however, has not proved to be sufficient. The other materials in a rubber compound are just as important in determining its aging quality as is the rubber itself. The requirement of "30 per cent new Hevea rubber" does not insure good life. On the contrary, restrictions on the chemical composition are claimed to have hampered the manufacturers in the development of better compounds through the use of organic anti-oxidants. What is needed is a specification based on tests which will adequately indicate the performance of the insulation for a period of years under service conditions.

About three years ago the Detroit Edison Company instituted a program of research to determine a satisfactory routine for aging tests on rubber insulation. This research has led to the formulation of a "performance test" specification which is radically different in several respects from those heretofore proposed, such as the ones sponsored by the electrical apparatus committee, N.E.L.A., and the A.S.T.M. The outstanding points of difference are the use of 250 hours instead of 96 hours for the aging period in the oxygen bomb and the introduction of dielectric-strength tests as a criterion of aging qualities. The justification for these requirements is shown in the results of the tests which will be described.

Causes of deterioration of rubber insulation

The chief causes of deterioration in rubber insulation can be classified into four groups:

(a) Oxidation, which manifests itself by a gradual chemical change through the mass.

(b) Ozone attack, which results in rapid localized destruction, evidenced by cracking. Ozone may be produced by corona or may be present in the surrounding atmosphere.

(c) Sunlight attack, which probably combines the effect of heating and ultra-violet light. The manifestation is a cracking similar to that of ozone attack with some additional, little-understood effects.

(d) Action of water, oil and very high temperature.

This study was concerned primarily with the effect of oxidation, ozone and sunlight.

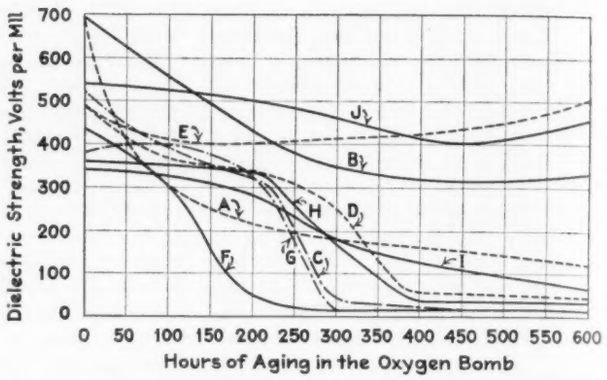
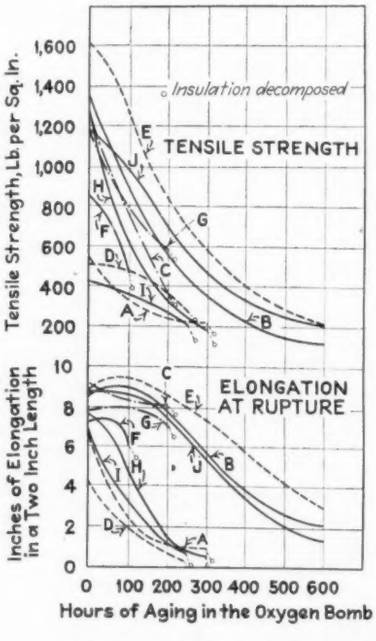


Fig. 1—Dielectric strength versus time in oxygen bomb

It can be seen that three of the brands stand out as superior in dielectric strength, maintaining a high value even after 600 hours of aging in the bomb. Of the three, brand E was a 30 per cent compound, brand J an intermediate compound and brand B was specified by trade name. Of the others, brand C was a 40 per cent compound, brands G and H 30 per cent compound, brand F was an intermediate compound and brands I and D were National Electrical Code compound. These results clearly indicate that the percentage content of Hevea rubber may have little to do with the quality of products as judged by these tests.



Three brands which were superior in dielectric strength are also superior in both tensile strength and elongation, and brand F, which gave the worst performance in dielectric strength, failed utterly after 100 hours in the bomb. This does not mean, however, that mechanical properties can be used in lieu of electrical properties in judging rubber insulation. Insulation with good mechanical properties is not necessarily a good dielectric. It is interesting to note that brand B, of evident superiority, would fail to meet the specification of a minimum depreciation of 25 per cent in tensile strength after an aging of 96 hours in the oxygen bomb. The same is true of the evidently poor quality brand C, which failed entirely after 200 hours in the bomb.

Fig. 2—Mechanical properties as against time in oxygen bomb

Oxidation Tests—Of the two recognized means of performing oxidation tests on rubber, the Geer oven and the Bierer-Davis oxygen bomb, the latter was chosen as being faster and giving repeatable results without difficulty. In order to go well beyond the 96-hour

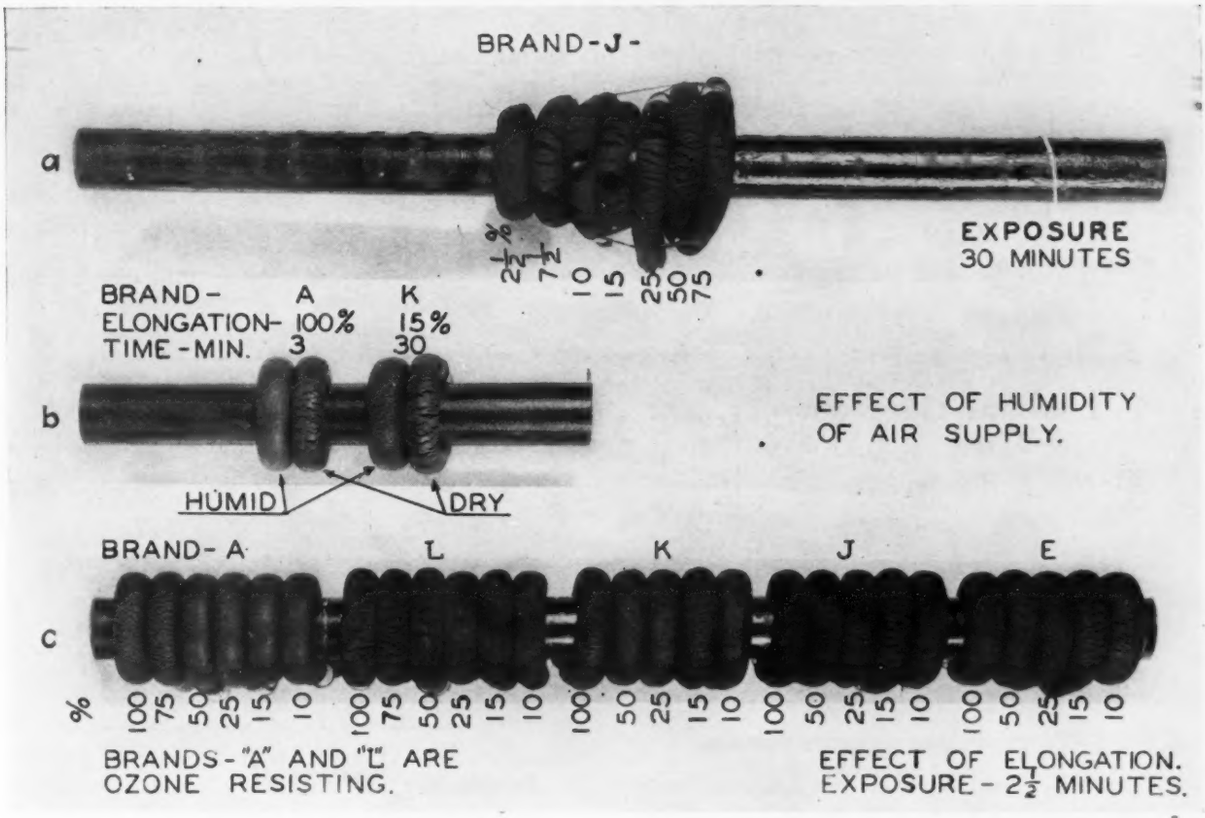


Fig. 3—Ozone tests on unaged insulation

Specimens bent around pipes to emphasize the degree of cracking after the ozone test. It is evident from the cracking in brands E, J, and K on pipe C that a critical elongation exists at about 15 per cent. It should also be noted that the so-called ozone-resisting compounds are subject to attack, having a critical point at a much higher value, however. This point is not clearly defined, but apparently is at about 75 to 100 per cent elongation. These compounds can be said to be ozone-resisting only at the lower elongations, since they show no attack up to 25 per cent. Elongations over 15 per cent are not likely to occur under ordinary conditions of installation, so the ozone-resisting qualities of these rubbers are of practical value. Comparison of the results on brand J after exposure for 2½ minutes (pipe c) and for 30 minutes (pipe a) indicates only a somewhat greater degree of cracking for the longer period, but the same critical point. The absence of cracking at 2½ per cent elongation, even under this extreme exposure, is noteworthy. Pipe b shows the importance of using dry air in getting prompt and repeatable results.

period usually specified and to assure overcoming the unstable conditions which appear in the early part of the test the period of aging was extended to 600 hours. For a criterion of aging special emphasis was placed on dielectric strength, since this quality is the important one in an insulation. Tests for tensile strength, elongation and set were also made to compare mechanical properties with electrical properties and to tie in with past work of others.

The oxygen bomb used was specially made of a 48-in. section of 8-in. steel pipe, closed at one end by a blank companion-flange and at the other by a companion-ring with a copper blow-out plate. The samples tested consisted of lengths of commercial grades of rubber-insulated copper wire, with an outer covering of one tape and one weatherproof braid. Two different sizes were used, No. 6 copper with 4/64-in. rubber and No. 2 copper with 4/32-in. rubber. Twelve different brands of insulation were tested, as indicated by the letters on the accompanying illustrations. The results shown are for samples aged while straight, then bent around a 3½-in. mandrel and immersed in water for the dielectric test. Mechanical tests were made on the whole section of insulation with the covering and wire removed. Each test result shown is the average of three samples. Only part of the results are given here, of course.

The outstanding conclusions to be drawn from these tests, as may be seen by reference to Figs. 1 and 2, are:

1. An aging period of 96 hours is too short for dependable results. At least 250 hours is required before a real comparison can be obtained.

2. The percentage of Hevea is no real indication of quality.

3. Dielectric strength does not vary with mechanical strength under aging. Both tests should be used.

The following table shows the minimum mechanical and dielectric qualities which have been selected for use in the Detroit Edison Company's specifications for rubber insulation:

	Ordinary Insulation		Ozone-Resisting Insulation	
	Upon Receipt, Min.	After Aging, Min.	Upon Receipt, Min.	After Aging, Min.
Tensile strength, lb. per sq.in.	1,000	350	400	200
Elongation at rupture (per cent increase in length)	300	100	300	75
Electrical breakdown voltage (volts per mil of average thickness)	....	250	...	250

Aging period, 250 hours at 300 lb. per square inch and 70 deg. C.

Tests not required on samples from each coil or reel, but only periodically to assure quality.

Ozone Tests—The ozone tests were made by passing air containing one part ozone to 5,000 parts of air through a chamber containing the samples at a rate of 10 cu.ft. per hour. These values were chosen as

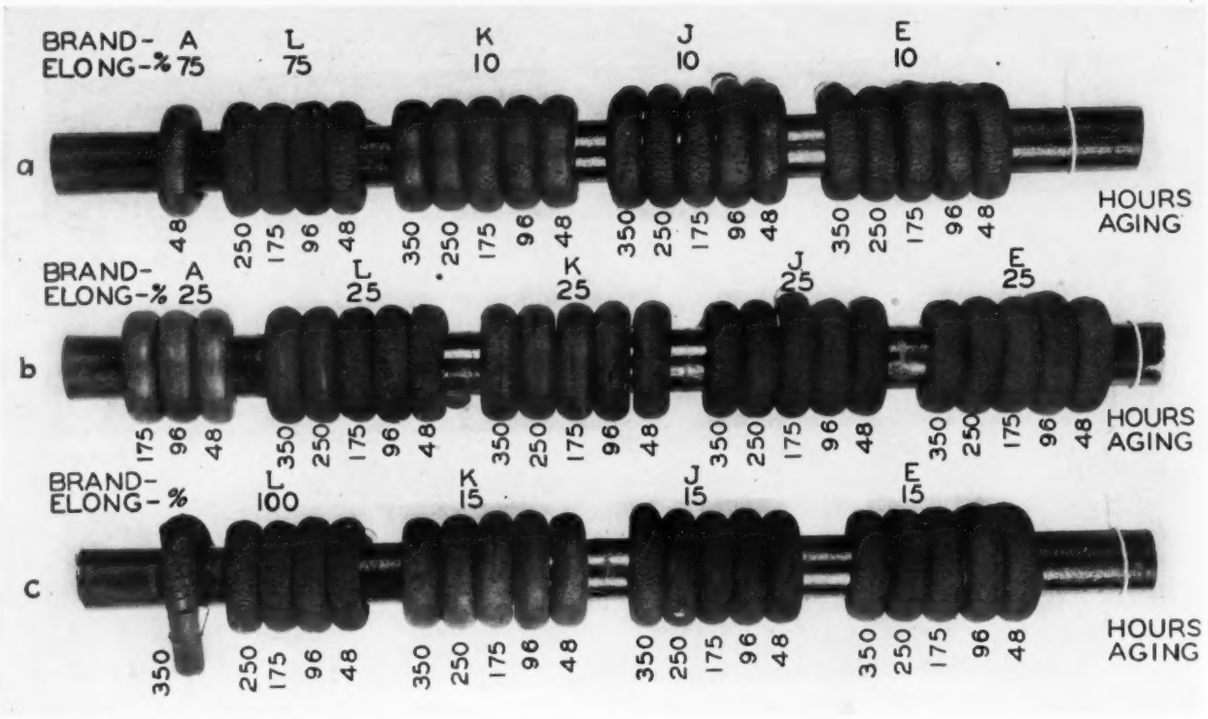


Fig. 4—Effect of aging on ozone cracking

On pipe a the ozone-resisting rubbers were stretched to 75 per cent and the others to 10 per cent elongation. On pipe c 100 per cent and 15 per cent were similarly used, these being near the critical points. Some of the specimens are omitted as they broke when stretched. On pipe b all samples were stretched to 25 per cent elongation. The hours of aging are indicated. It is evident that aging has little effect on ozone attack except possibly in the case of brand L at 25 per cent elongation, for which the attack decreased somewhat with the aging.

giving practicable results, there being no accepted standards. The samples were stretched on a rack to different degrees of elongation, from 2½ per cent to 100 per cent, since ozone attack varies with mechanical stress. Both new samples and those aged in the oxygen bomb were tested. The effect of the ozone attack was judged by the severity of the cracks which appeared.

The following conclusions may be drawn from the results shown in Figs. 3 and 4:

1. A critical elongation for maximum ozone attack exists in all rubbers tested. This is at about 15 per cent for ordinary compounds and 75 to 100 per cent for ozone-resisting compounds.

2. Aging has little effect on the susceptibility of rubber to ozone attack.

The Detroit Edison specification includes the following test requirement for ozone-resisting insulation: "Exposure to an atmosphere of dry ozone of a concentration of one part of ozone to 5,000 parts of dry air (by volume) for 2.5 minutes while being subjected to a tensile stress which elongates it to 115 per cent of its initial length, without showing any evidence of cracking or other deterioration."

Sunlight Tests—The effect of ultraviolet rays was studied on a limited number of samples. There is an apparent connection between the effects of ultraviolet and of ozone. The characteristic cracking found in the ozone tests is also present in the samples subjected to ultraviolet. The theory that the agency was ozone in the latter case led to the irradiating of rubber insulation in a Corex D bottle under vacuum, in the presence of nitrogen only, and also in the presence of air. Only in the presence of air did the rubber develop the characteristic cracking caused by ozone. That there is still another factor in the deterioration was indicated by tests at different elongations on one sample. Instead of the marked critical condition at 15 per cent elongation and decrease of severity of cracking with greater elongation the cracking increased in severity as the elongation was increased.

The specification which has resulted from this research, the most pertinent requirements of which have been given, is now being used by the Detroit Edison Company in purchasing rubber-insulated wires and cables. It is not intended to infer by the title of this article, "Adequate Specifications for Rubber Insulation," that these specifications are finally adequate. There still remains much to be done in the study of rubber aging. The purpose, rather, has been to point out the inadequacy of past specifications and to describe the steps which have been taken toward the development of one which will be more satisfactory.

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Adjusting Energy Takings Under Firm-Power Contract

Under the primary power contract between the Edison Electric Illuminating Company of Boston and the New England Power Company the former agrees to pay $2,025,000 per year for 150,000,000 kw.-hr. delivered to its system. The total input may be 75,000 kw. for 2,000 hours' use of the demand. Service began under this contract October 1, 1930, and is to extend for twenty years from that date. As a result of experience in intercompany billing, it has been decided to vary the payments from month to month to bring the billings into closer

accord with the energy transfers than where one-twelfth of the annual total is paid to the power company by the Edison company per month. Both companies desired to have the amount of payment more closely follow the energy deliveries. A supplementary agreement to the contract was therefore written to take care of this matter.

The price per kilowatt-hour under the contract is 13.5 mills. The contract was changed to bill Edison each month at the rate of 4 mills per kilowatt-hour taken plus a fixed charge, which is one-twelfth of 150,000,000 kw-hr. at 9.5 mills each. The payment over the year remains at $2,025,000, but it is spread to be a little less in summer and a little more in winter. If the 150,000,000 kw.-hr. is not exactly taken in a year, the Edison company has the right to postpone the taking into the next contract year. The contract provides for negotiating the price of energy on the firm power basis every five years, and as it was signed by the heads of the two participants in 1928, a reconsideration of the price is scheduled before October 1 of this year. The scheduled takings of energy on the firm power basis from New England to Edison follow for the first nine months of 1933, in millions of kilowatt-hours: 16.5; 13.5; 11.5; 10; 9.5; 9.5; 9.5; 10 and 12.

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Rational Scheme for Computing Motor Costs

By E. BALLMAN
Baldor Electric Company, St. Louis, Mo.

LACK of actual cost data in the ordinary manufacturing plant is responsible to a great extent for the extreme variation in motor prices that has been on the market in recent years. Where only a few sizes and types are built, the ordinary cost methods are quite accurate and reliable. If a large number of sizes and types are manufactured, the compiling of the actual cost data is expensive and unsatisfactory for the ordinary small manufacturer. From data collected by the Baldor Electric Company the following method of cost estimating has been compiled and its operation checked over a number of years in manufacturing electric motors in sizes from 10 lb. to 400 lb. weight.

A line of electrical motors of the above range of sizes is usually designed so that their shapes are alike; that is, the relation of length to diameter is the same in all sizes, but dimensions vary with the size. Also the various sizes are a definite function of the diameter of the stator punching.

From time studies and established satisfactory piece prices it has been found that by plotting labor and the diameter of stator punchings fairly smooth curves are obtained. Using the usual analytical methods the equations of these curves are obtained. The formula thus obtained is:

$$\text{Labor} = K \times D^{2.4}$$

Labor is the direct labor in dollars for a motor.
D is the diameter of stator punching in inches.
K is a constant depending upon the grade of workmanship, type of motor, quantity in production, etc.

While the value of K may be determined from time data on a definite size of motor, the following method is quite different and gives a much more accurate average value of K. By this method instead of working from a time study of a particular size we start with the data obtained from the auditing and shipping records.

Knowing the number of motors shipped per year and the number of orders, the average size quantity of an order is obtained. From the yearly payroll we obtain the total dollars of direct labor. Now, for example, having three sizes of frames or punching sizes we can write the following equations from the shipping records we made during the year:

"A" number of motors having punching diameter d_1
"B" number of motors having punching diameter d_2
"C" number of motors having punching diameter d_3
Labor for the "A" group of motors is $K \times A \times d_1^{2.4}$
Labor for the "B" group of motors is $K \times B \times d_2^{2.4}$
Labor for the "C" group of motors is $K \times C \times d_3^{2.4}$

But we know the total labor (L) from the payroll, so

$$L = K\ (Ad_1^{2.4} + Bd_2^{2.4} + Cd_3^{2.4})$$

$$\text{or } K = \frac{L}{Ad_1^{2.4} + Bd_2^{2.4} + Cd_3^{2.4}}$$

Substituting the actual figures for L, A, B, C, d_1, d_2, d_3, then the actual value of K is easily obtained. The value of K thus obtained reflects all the complex factors arising in the actual plant operations. Knowing K, it is easy to obtain the labor dollars for each size frame or motor. Due to change in methods and rates of pay this constant K should be calculated each year.

For a given line of special motors manufactured in approximate lots of ten the value of K is approximately 0.0521, giving labor in dollars.

Of course, where larger quantities of motors are built in a lot the above value of K is reduced. The table below gives some approximate values of K for different-sized lots:

Size of Lot	K
10	0.0521
50	0.0381
200	0.0355
100	0.0349

Where it is desired to calculate the cost of some special motor built in one of the above frames the following procedure has been established: The special motor is designed and its weight either calculated or weighed upon completion. From the material chart the actual material cost is obtained. Using the previous data, the labor cost per pound of each size frame is obtained, and knowing the above actual weight of the specially designed motor it is fair to assume that the labor of the special design will be approximately proportionate to the weight. The following table gives the labor cost per pound of a range of commutator motors made in lots of about ten, or $K = 0.0521$.

Motor Weights, Lb.	Labor per Pound, Cents	Motor Weights, Lb.	Labor per Pound, Cents
10-35	14.9	76-125	11.5
36-50	13.6	126-200	9.9
51-75	12.9	200-400	8.6

These figures were obtained from a year's satisfactory operations. Where orders are in larger lots, then the above labor prices per pound can be reduced proportionally as K is reduced in the first table.

Thus, in the case of special motors having weights and machining somewhat different from a standard motor, but of the same type, the labor and material cost may be quite accurately estimated by the above-described method.

Overhead easily added

While the foregoing has been devoted to the calculation of the labor and material costs, it is quite fitting that the method of obtaining the net factory sales price be described. From the auditing records the overhead factors for both material and labor are obtained, and then the

$$\text{Net factory sales price} = sM + tL$$

where M = material and supplies.
s = overhead factor.
L = labor direct.
t = overhead factor including profit and total expenses.

The above methods have been presented because the usual cost system is based upon estimating and measuring a large number of small items, and the routine to do this is usually costly and difficult to complete. While the above method may not be entirely accurate, the figures obtained by its means are safe in that the total money actually spent in labor during a year's or more operations is used to obtain the labor cost for each unit. This money is actually divided and proportioned to agree with a definite law, and even if not exactly correct the results are consistent. With each year's operations more accurate results are obtained and corrections easily made.

Costs based upon the above method are easily calculated, and the use of this system would eliminate some of the absurd prices that recently have crept into the motor market. Of course, the constants above should be calculated for each factory, using the exact factory records in order to obtain accurate results.

Metered Lighting Cabinets

Close check-up on the costs of various processes or departments often requires metering of individual electric services. One plant has standardized on incorporating the meter in the lighting or small power cabinet as shown in the accompanying illustration. With the present sheet-steel and welding type of fabrication individual cabinets designed for specific purposes can be made up in this manner with little additional cost. Advantages of this construction are the accessibility of the meter for reading purposes and the tamper-proof features. Neatness and protection from damage also are obvious advantages.

What Determines Success of Fall Lighting Program?

"The National 'Better-Light, Better-Sight' program is national only in that the summation of a large number of local selling activities becomes a national stimulation to sales of light and of lighting equipment. It depends entirely upon a lighting activity in each locality which feels that now is the time to get back that lighting which has been lost, using the new salesmanship in lighting which adversity has brought to us.

"It will succeed only where all responsible persons in local utilities are willing to spend some money for a lighting activity in their territory and are willing to work with their local representatives in other branches of the electrical industry along some practical, simple plan devised jointly to meet the requirements of and peculiar conditions surrounding that particular locality.

"It will fail in those places where members of the industry scoff at a plan so simple, do not bestir themselves, cannot agree among themselves, devote their entire energies to selling phases involving the use of electricity other than for light, or refuse to spend an adequate amount of money.

"Each of you as individuals alone can control whether you will, in your locality or localities, contact others who have a common interest and then help to work out a plan for lighting sales this fall. If you think well of the idea, each of you can do something designed to fit your particular needs in conjunction with those of your associates. Then, when we look back upon the fall of 1933, we will find that there has been a tremendous stimulation nationally in the sale of lighting and lighting equipment in the United States."

GEORGE E. WHITWELL,
Chairman Sales Committee, Edison Electric Institute.

Heat Dissipation From Network Manholes

By L. A. NETTLETON*

Brooklyn Edison Company, Brooklyn, N. Y.

Brooklyn tests determine temperatures for network manholes containing 500-kva. transformers.
Ventilation and transformer loading under cyclic conditions discussed.
Developments of practical installation principles.

THE economical design of low-voltage alternating-current networks makes it desirable to concentrate the required transformer capacity in as few units of comparatively large ratings as is consistent with total cost, satisfactory voltage regulation and the ability to burn off secondary faults. The dissipation of heat from unventilated manholes is usually insufficient for the larger sizes of transformers and special means of ventilation, such as fans or ventilating ducts, are sometimes resorted to. It is possible to design manholes in such a way as to produce natural ventilation without appreciable increase in cost or complication. The ventilated type of manhole developed in Brooklyn has proved capable of dissipating approximately twice as much heat as an unventilated one and can be used with transformers up to at least 500 kva. in rating.

The heating constant of a manhole, or temperature rise of manhole air per unit of heat dissipated, is affected by so many variables that an accurate analysis is hardly practicable. However, an approximate heating constant, which is sufficiently accurate for most practical purposes, can be determined by means of a few simple tests. With this heating constant and the necessary load and loss data it is possible to predetermine manhole temperatures with enough factor of safety to allow for such variations as are ordinarily met with in practice.

The permissible loading of a transformer installed in a manhole is a function of the transformer losses, the 24-hour load cycle, the season of the year and the combined heat-dissipating ability of transformer and manhole. This permissible loading, as determined for a given set of conditions, may be considerably different from the nameplate rating of the transformer.

Type of installation

Previous to the installation of a.c. network the usual type of manhole was 4½ ft. wide by 8 ft. high by 14 ft. in length and the maximum installed capacity consisted of two 100-kva., 2,400-volt, single-phase transformers. A single, centrally located, opening was covered by a 35-in. circular cast-iron cover and except for a few small holes in this cover the manhole was unventilated.

On the a.c. network the usual equipment consists of a 500-kva., three-phase, self-contained, network transformer unit. The network protector is housed in a watertight compartment mounted on one end of the transformer tank, while a high-tension pothead or terminal chamber is located at the other end. The complete unit is 4 ft. wide by 7½ ft. high by 10 ft. in over-all length. More detailed information concerning the network apparatus and the layout of the network system can be found in papers previously published.†

The 500-kva. manhole used with the three-phase transformer unit is similar to the 200-kva. manhole except for the length, which is increased to 17 ft. The size of the network transformer resulted in a somewhat unusual method of installation. The unit is first placed in the open hole, after which two removable roof slabs are set in place and the street paving restored. Access to either the high-tension or low-tension end of the unit is provided by means of two 35-in. square openings at the extreme ends of the manhole. The improved ventilation of this type of manhole is partly due to the arrangement of the transformer in the manhole and partly the result of using ventilating covers.

In addition to a large number of transformer installations there are also a few installations of three-phase shunt-connected reactors. The shunt reactors are similar in appearance and construction to transformers except that there is only one set of windings and the core is designed with air gaps. The reactors draw a wattless current and are used as loading coils to neutralize the charging current of 27-kv. feeders so that possible back-feed to a long cable from a network transformer cannot result in excessive current or voltage rise.

The temperature rise of a transformer in a manhole must be separated into the rise of the transformer above manhole air and the rise of the air in the manhole above some temperature of reference. Transformer temperature-rise data are ordinarily referred to an ambient air temperature which is the temperature flowing in toward the base of the transformer before it is influenced by dissipated heat. Under test conditions this is usually the same as room temperature, but in a manhole the temperature of the air at the base of the transformer may not be the same on all sides. Also, the confined space often acts to change the velocity and direction of air convection currents, with a consequent effect upon the transformer temperature. In the preliminary investigation of a given type of installation it is necessary to measure the hot-oil or shell temperature of the transformer and to subtract from this the calculated transformer temperature rise in order to find the "effective" manhole ambient air temperature, or ambient temperature that would produce the same transformer tempera-

**Based upon paper presented before underground systems committee, N.E.L.A.*

†Recent Progress in Distribution Practice of the Brooklyn Edison Company, Inc., Fairman and Rifenburg, page 1187 A.I.E.E. Transactions, 1926. Why Brooklyn Adopted Low-Voltage A.C. Networks, J. A. Brooks, ELECTRICAL WORLD, *September 14, 1929.*

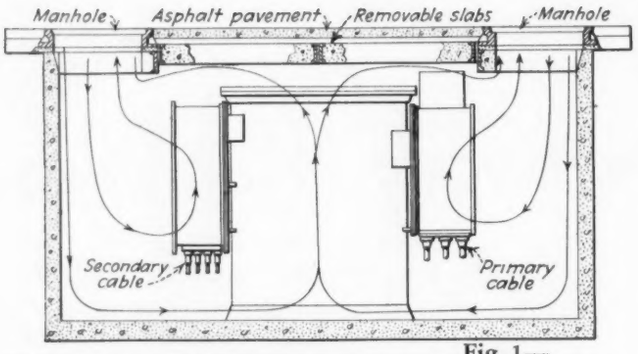


Fig. 1—Transformer manhole with 500-kva. transformer

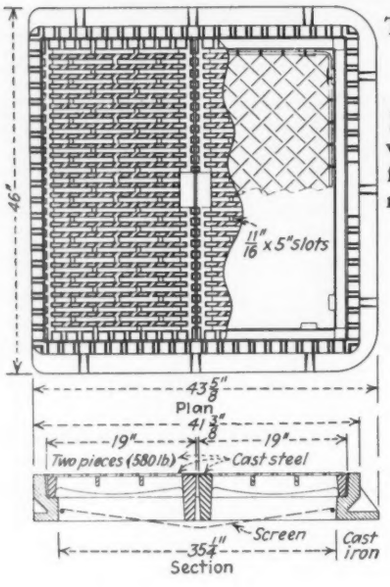


Fig. 2—Typical ventilated cover for 500-kva. manhole

ture conditions on the test floor. In a standardized manhole installation a location can usually be found where the air temperature will consistently approximate this effective ambient temperature. In such case this location can be used for recording thermometer measurements in subsequent testing without the necessity of calculating the transformer temperature rise in every case.

Once the heating charactristics of a given type of manhole are definitely known it becomes possible to calculate the maximum transformer temperatures for any time of the year and for any conditions of loading.

Manhole temperature tests

In investigating the relation between the air temperature in the manhole and the various controlling factors the following groups of tests were made:

A. Monthly tests of four typical transformer installations over a period of one year. Each test lasted 24 hours with loads and temperatures read every hour. The air temperatures were read by means of ordinary mercury thermometers, one at each end of the transformer.

B. Tests on seven shunt reactor installations, each test lasting 24 hours. The temperatures were taken by means of recording thermometers. It was not necessary to measure the load since the reactors operate at contant load.

C. Tests on fifteen typical transformer installations, each test lasting 24 hours. Recording thermometers were used to measure air temperature. Only two load readings were taken in each test, one during the day and one at the time of lighting peak.

In the tests of groups A and B the air temperatures were measured by thermometers located about 4 ft. above the floor and 6 in. from the high-tension pothead or low-tension compartment, a location which was subsequently found to give values slightly high for the "effective" ambient air temperature in the manhole. It was also found that air temperatures in the manhole seldom varied more than 5 deg. C. over the 24-hour period in spite of a considerable variation in temperature of the air in the street.

The effect of a variation in ambient air temperature upon the transformer copper temperature is illustrated in Fig. 3. The assumption of a constant ambient air temperature in Fig. 3 gave a maximum copper temperature about one degree too low. This error is less than the variation in temperature between individual transformers built to the same specifications. To simplify the analysis, we may therefore assume that the temperature rise of a transformer installed in a manhole can be referred to an ambient air temperature, T_a, which is the average effective air temperature in the manhole over 24 hours. From this assumption it necessarily follows that the ultimate temperature of reference, T_r, to which T_a is referred, is also an average temperature over 24 hours.

The temperature rise of the manhole air above the ultimate temperature of reference must be equal to some function of the average losses over 24 hours. Earlier tests on a 200-kva. manhole indicated that this temperature rise (T_a—T_r) starts as a linear function of the average losses over 24 hours (W), decreasing to the 0.8 power of the losses at about 5 kw. and decreasing still further at higher values of loss. However, the accuracy of field data and the variations encountered in practice do not justify any greater refinement than the assumption of a linear law. Therefore

$$T_a = T_r + H\,W \text{ or } H = \frac{T_a - T_r}{W}$$

Where

T_a = average effective manhole air temperature (°C) over 24 hours.
T_r = average temperature of reference (°C) over 24 hours.
W = average losses over 24 hours in kw.
H = heating constant in degrees per kw.

This formula fulfills the requirements of the investigation, *i. e.*, to determine a simple and easily applied rule for predetermining manhole temperatures. It remains, however, to find the proper temperature of reference and to evaluate the heating constant.

The yearly curve of manhole air temperature T_a, taken from one of the tests of group A, is shown in Fig. 4. As it happened, the losses did not vary much over the year and we would therefore expect the manhole air temperature to show a nearly constant rise above the true temperature of reference. This curve indicates that the temperature of reference, T_r, is either the air in the street or the soil of 2-ft. depth.

The heating constant, H, for all four tests under group A is plotted in Fig. 5. There is a discrepancy between the four tests in October due to one transformer being tested about two weeks later than the others. The lower group shows slightly less variation in the calculated heating constant, H, over the year. The mean air temperature in the street is therefore selected as the most logical temperature of reference T_r. It has the additional advantage of being readily obtainable from Weather Bureau records.

It should be pointed out that the street air temperature curve in Fig. 4 represents the mean yearly temperature variation, although the actual 24-hour average temperature may deviate from the curve by 4 deg. C. or more. This accounts for the up-and-down variations of the heating constant in Fig. 5. More consistent results can be obtained if the Weather Bureau daily mean temperatures for the period of the test are used in place of

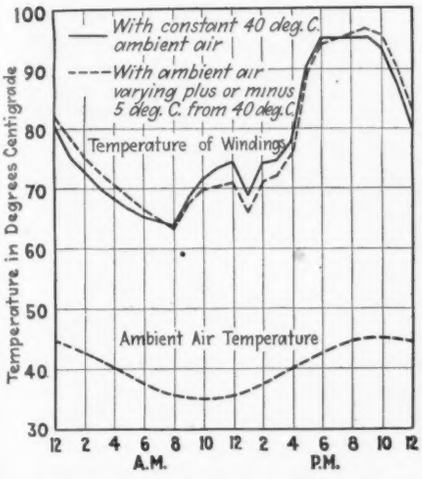

With constant 40 deg. C. ambient air
With ambient air varying plus or minus 5 deg. C. from 40 deg. C.
Temperature of Windings
Ambient Air Temperature
Temperature in Degrees Centigrade
A.M.
P.M.

Fig. 3 (left)—Calculated transformer temperature curve based on a typical load cycle

In Fig. 3 the transformer is assumed to operate on a recurring 24-hour cyclic load.

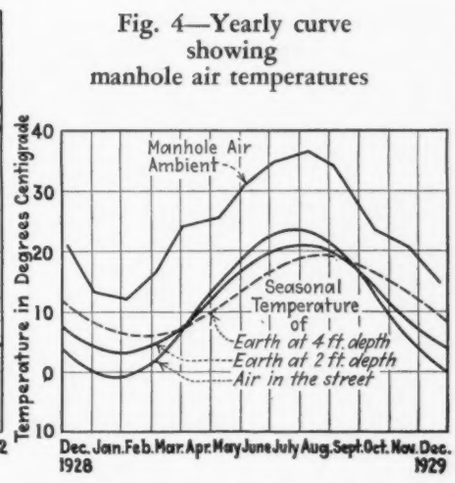

Manhole Air Ambient
Seasonal Temperature of
Earth at 4 ft. depth
Earth at 2 ft. depth
Air in the street
Temperature in Degrees Centigrade
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1928
1929

Fig. 4—Yearly curve showing manhole air temperatures

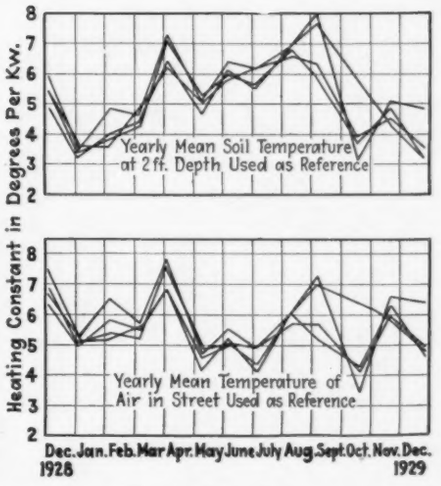

Yearly Mean Soil Temperature at 2 ft. Depth Used as Reference
Yearly Mean Temperature of Air in Street Used as Reference
Heating Constant in Degrees Per Kw.
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1928
1929

Fig. 5—Heating constants of manholes from test data

the air temperature curve from Fig. 4. Actual charts of street air temperature in the vicinity of the manhole have invariably checked closely with the Weather Bureau records.

The fact that the outside air temperature rather than the soil temperature gave the most consistent temperature of reference indicates that more heat must be carried away by the ventilating air and by conduction through the roof than by conduction through the side walls to the earth. An experiment was made to determine the ventilating process by placing an observer in the manhole and introducing smoke at the surface of the cover grating. It was found that the smoke entered through the farther side of the grating at the end of the manhole and passed down the side walls to the floor and along the floor toward the transformer. Between the tank and the side walls the air current turned vertically upward toward the roof, passing along the roof toward the grating, and out the nearest side of the grating. It seems probable that the location of the transformer at the center of the manhole between the two openings is responsible for the air circulation and doubtless the effect is enhanced by a strong "chimney effect" resulting from the narrow clearance between the sides of the transformer tank and the manhole walls. There is some evidence to show that slight changes in transformer dimensions have some effect upon manhole temperatures.

The deep rib in the manhole covers acts as a baffle to separate inflowing from outflowing air. Tests were made with these covers turned 90 deg. from the usual position, so that the ribs lay parallel to, rather than across the longitudinal dimension of, the manhole, and the manhole heating constant was increased by 15 to 20 per cent. Another experiment was made to determine the effectiveness of ventilation by blocking off the ventilation of both covers and resulted in doubling the manhole heating constant.

The air temperatures in the tests under groups A and B were taken in locations too high above the floor and were influenced to some extent by heat dissipated from the transformer. As a result the calculated heating constant is slightly high. The temperature of the stream of air entering between the transformer and manhole wall was found to be too low for the effective ambient temperature. A satisfactory location was found directly in front of the transformer and near the floor, and this location was used in the tests of group C. Since these tests were made on a larger number of units and covered a wider range of service conditions, the results are used in preference to the results of the tests of groups A and B.

At the time the tests of group C were made it had already been established that the average loss rather than the maximum loss was the determining factor and therefore two sets of load readings were found to be enough, one during the day and the other at the time of lighting peak. The units were not loaded to full capacity, and it was possible to estimate the average losses with sufficient accuracy from these readings.

The average heating constants from these tests are:

Group A 5.6 deg. C. rise per kw. of average loss.
Group B 4.9 deg. C. rise per kw. of average loss.
Group C 4.8 deg. C. rise per kw. of average loss.

The results of the group C tests are given in the accompanying table. The variations in the constant H can be accounted for (with one exception) by a plus or minus 4 deg. difference between the actual 24-hour mean temperature of air in the street and the value obtained from the yearly curve of Fig. 4. In the exceptional case, the low constant of 2.7 may have been caused by a

Test on Fifteen Transformers

Test No	Date	T_a (Manhole Temp.)	T_r (Street Air Temp.*)	T_a-T_r (Manhole Air-Temp. Rise)	W (Average Loss in Kw.)	H (Deg./Kw.)
1	July 22-23, 1930	36.0	23.5	12.5	2.4	5.2
2	July 22-23	38.5	23.5	15.0	2.6	5.8
3	July 22-23	37.0	23.5	13.5	2.1	6.4
4	July 23-24	37.0	23.5	13.5	2.6	5.2
5	July 23-24	33.5	23.5	10.0	2.1	4.8
6	July 23-24	36.0	23.5	12.5	2.6	4.8
7	July 24-25	35.0	23.5	11.5	2.4	4.8
8	July 24-25	35.5	23.5	12.0	2.4	5.0
9	July 24-25	33.0	23.5	9.5	2.4	4.0
10	July 25-26	30.5	23.5	7.0	...	...
11	July 27-28	33.0	23.5	9.5	2.0	4.8
12	July 28-29	32.5	23.5	9.0	2.1	4.3
13	July 28-29	30.0	23.5	6.5	2.4	2.7
14	July 29-30	31.5	23.5	8.0	1.8	4.5
15	July 30-31-Aug. 1	33.5	23.5	10.0	2.0	5.0
Average heating constant						4.8

*From yearly curve, Fig. 4.

Fig. 6—Typical loading curves for a network transformer

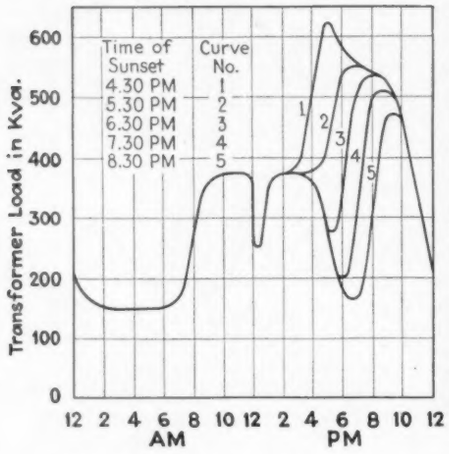


Fig. 7—Periods at which typical load curves apply

For load curves indicated see Fig. 6

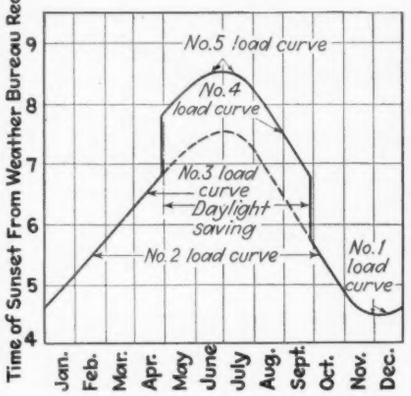
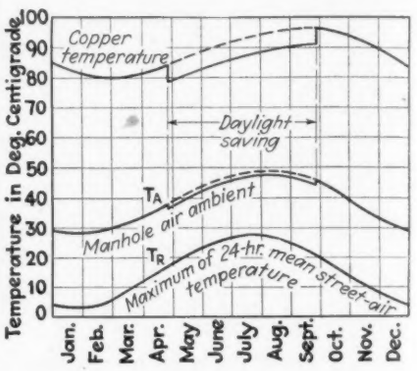


Fig. 8—Variation in transformer temperature over a year for assumed load curves



breeze blowing in one opening and out the other, which occasionally happens.

In predetermining air temperatures for this particular type of manhole the heating constant H may be taken as 5 deg. per kilowatt. However, the value of T_r as taken from a yearly curve of mean air temperatures such as the curve in Fig. 4 must be increased by at least 4 deg. C. to allow for the maximum temperatures that may prevail.

The results of a few tests upon miscellaneous installations of transformers in old-type 200-kva. manholes gave heating constants averaging about 11 deg. C. per kilowatt. It is interesting to note that the slightly larger 500-kva. manhole gave a corresponding constant of 10 deg. C. per kilowatt with the ventilation entirely blocked off. Non-ventilating covers would require derating the present network units by about 20 per cent, whereas the normal installation allows the use of 500-kva. transformers with a reasonable margin for overloading during contingency conditions.

Seasonal variation in transformer temperatures

The safe load that can be carried by a transformer installed in a manhole is not only a function of the transformer thermal characteristics, but also the heat-dissipating ability of the manhole, the load cycle and the season of the year. This can be illustrated by the following example:

It is assumed that a typical 55 deg. C. rise transformer of 500-kva. rating having losses of 7.5 kw. at rated load is installed in a 500-kva. manhole and required to operate at 125 per cent of rating during the peak period of the year. It is further assumed that the same load remains connected to the transformer for a year with no allowance for growth. This load is assumed to consist of a power and base load upon which is superimposed a lighting load. The lighting load is corrected for each hour's difference in the time of sunset from 4:30 p.m. standard time in winter to 8:30 p.m. daylight-saving time in summer (Fig. 6).

The transformer temperature rises above manhole air were calculated for each of these load curves on the assumption of a recurring load cycle. The transformer temperature calculations were made according to the method given by Cooney,‡ but for convenience of application to a typical load cycle the method was modified by the step-by-step process developed by Kirke¶ for cable temperature calculation. The copper rise above oil has a time lag of less than one hour and is added directly to the hourly steps of oil temperature rise. The temperature rise of manhole air above the air in the street was based upon a heating constant of 5 deg. C. per kilowatt using the average losses corresponding to each of the five load curves. Fig. 7 shows the season of the year when each load curve applies.

In Fig. 8 the temperature curves of manhole air above street air and of transformer copper above manhole air are added to the curve of street air temperature at the appropriate times of the year. The resulting curves show the range in manhole air temperature and transformer copper temperature over the year.

It is readily apparent from Fig. 8 that for the particular type of load considered the maximum temperatures occur early ir October. A purely lighting load, having very little load during the day, will also result in maximum temperatures during October. However, if the lighting load is negligible, the maximum temperature will be found during July and August.

It should be emphasized that the standard rating of a transformer is not a reliable indication of its capacity when installed in a manhole. The permissible value of load is greater during the winter than during the summer and the amount of this load depends directly upon the heat-dissipating characteristics of the manhole. In the example given the transformer proved to be able to carry the connected load throughout the year, neglecting the slight over-temperature around October 1. Although in December the assumed peak load was 125 per cent of rating, the losses averaged only 5 kw. over the 24 hours. If we substitute a constant load of 100 per cent rating the copper rise would be 55 deg. over ambient manhole air and the rise of the manhole air over street air would be $7\frac{1}{2}$ kw. $\times$ 5 or $37\frac{1}{2}$ deg. This total rise of $92\frac{1}{2}$ deg. above street air under continuous rated load is considerably greater than was the case when operating on a typical load cycle at 125 per cent load, and the transformer would exceed the normal 95 deg. temperature limit except on cold days with street air at $2\frac{1}{2}$ deg. or less.

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‡*Predetermination of Self-Cooled Oil-Immersed Transformer Temperatures, W. H. Cooney, page 611, A.I.E.E. Transactions, 1925.*

¶*The Calculation of Cable Temperatures in Subway Ducts, W. B. Kirke, page 855, A.I.E.E. Journal, October, 1930.*

Good Will Gained by Tolerance With Delinquent Customers

DURING the congressional hearings on the 3 per cent federal tax soon to go into effect it was stated that delinquency on electric consumers' bills amounted to $100,000,000. Since that time the tone of business has changed for the better and undoubtedly collections for electric service have also begun to improve. But there will be a continuing period for a decreasing fraction of the consumers during which a modified collection technique will have to persist. In order to show the extent of and the humanity in the methods devised for handling delinquent customers ELECTRICAL WORLD has assembled the statistics and the philosophy of companies typical of all sections of the country. One thing stands out above all others in this survey and that is that the utility companies generally have risen to the occasion and as far as their resources would permit have taken a sympathetic and social-minded stand with respect to such of their customers as have been passing through a period of intense financial distress.

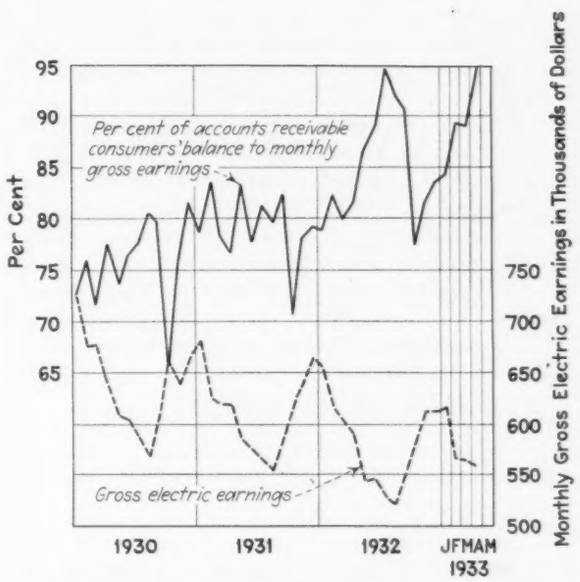
Thousands of families without jobs and without funds have been tided over without loss of the benefits of electric service. The means of doing this has varied among the companies, but in every case it has involved a modification of the former technique and a broader range of co-operation with welfare and relief agencies. Nowhere is there any evidence that the intent was to engage in philanthropy nor, on the other hand, can there be found in any of the plans a dominant tone of "it's just good business to be lenient." In all of them appears the fact that the utilities have been humanized by their own troubles during the depression and have quite naturally reflected their tempered attitude in dealing with customers similarly situated.

Delinquency has nevertheless thrown extra work, extra expense and extra responsibility on the utility companies at a time when decreased income and increasing taxes might easily have justified rigor in collections as the part of discretion and safety. Strong effort, however, has been made in the plans to squelch the contagious idea that the companies were merely relaxing their vigilance or that all accounts would be allowed to run. Whether all customers would be advised that the company was prepared to extend credit to the legitimate needy was a matter that differed among the utilities. A few companies felt there was virtue in making the announcements public, but in such phrases as to indicate that the offer was restricted to those who could conscientiously take advantage of it.

Delinquency mostly in residential class

As for statistics, one Eastern company's status gives a good picture of the magnitude and distribution of the delinquency problem. The residential and commercial customers constituted 99.88 per cent of the total number of delinquent customers and the industrials constituted another 0.11 per cent. In dollar volume the recent status was:

	Dollar Delinquency — Months	Per Cent	
Residential and commercial	1	38.93	
	2	21.56	
	3	13.18	
			73.67
Industrial			24.69
Municipal, county, state and federal			1.64
			100.00



Delinquencies went up as earnings went down

Delay in bill payment lengthened as consumption decreased, beginning in 1930. Apparently high normal percentage of accounts receivable due to charging to accounts receivable as soon as billed. October dips due to the company's (Hartford Electric Light) practice of granting "customer dividends" on bills of that month.

Another Eastern company in April had 15.6 per cent of its customers delinquent and the sum involved was 16.9 per cent of the billings. A Middle Western utility company in a city which has had unusual depression found 51 per cent of its delinquent accounts in the residential group (84 per cent of the customers) and the rest of the delinquent customers and accounts in the commercial and industrial classes. The basis for these proportions is not exactly the same for all companies nor is the criterion for delinquency the same. Consequently the general trend through the past winter and spring can perhaps best be sensed by the three-year trend of the deliquency item indicated as the marginal fluctuation of the proportion of the accounts receivable to gross electric earnings. This is shown in the accompanying illustration for the Hartford Electric Light Company, whose credit

certificate plan was described in detail in the N.E.L.A. *Bulletin* for February, 1933. The end-of-the-month accounts receivable reached a peak of 94.9 per cent in July, 1932. February saw another rise begin toward a second high of 94.8 per cent in April, unmistakably associated with the bank stringency and the bank holiday of early March. Since then the trend is toward reduction. October is the month in which Hartford applies its customer dividend to the bills. Up to the end of 1932 the company had issued credit certificates to 3,981 customers (6.6 per cent of all) in the total amount of $22,069, as against a gross earnings figure of some $580,000 per month. A West Coast company likewise saw its ratio of outstanding accounts receivable to gross revenue increase from 87.8 per cent in 1928 to 104.77 per cent in 1932.

Detroit Edison's president, Alex Dow, in his letters in the newspapers to his customers said only 28,200 deposits were being carried against 525,000 accounts, although there were 106,600 customers delinquent. Losses in bad debts had tripled to $601,000 between 1928 and 1932. The overdue accounts at the end of April were stated by Vice-President Sheridan to have grown to $1,601,000, more than five times the figure of four years earlier. This change attended a shrinkage of 22.8 per cent in gross revenue during the same period.

Prevailing collection technique modified

More or less extensive modification of prevailing collection technique has been one means of meeting the delinquency situation. On this point an Eastern company says:

> During this period of depression we have suspended our regular collection procedure on one-month accounts except those who are habitually delinquent and regularly receive a cut-out notice. This method allows our collection department to spend time on accounts that are more than one month delinquent. We have also been very liberal in our policy of granting extensions of time on requests of customers. In many instances we will take an agreement with the customer to pay current bills at maturity plus a small portion of any arrears which are past due. Further, we have made every effort to get back on our lines customers who have been discontinued for non-payment, by either placing the account on a weekly basis or by taking agreement to pay off their outstanding balances in small monthly payments."

A central states company reports as follows on this point:

> During the year ended April 30, 1933, our collectors discontinued service for non-payment on only 5.2 per cent of their calls. This figure averaged 12.5 per cent for the twelve months ended April 30, 1929, a period prior to the depression. In dealing with delinquent accounts today we consider the customer's record in the light of how he paid during more normal years or prior to 1930. Only as a last resort do we discontinue service to customers who at one time established a good record. Instead, we endeavor to get them to adjust their use more in keeping with their present means and then arrange to accept partial payments which will take care of their current bills for the time being.

In cases where the credit certificate plan has been adopted (especially Hartford and Poughkeepsie) the modification of the discontinuance-for-non-payment policy naturally involves the certificate procedure. Thus:

> . . . deferring immediate payment of any accrued arrears and extending the privilege of using our service for a period of three months to be paid for as the customer is able. After the three months period a current review is made of each case and further extension is made, if necessary. Commercial accounts have in general been required to meet their obligations for gas and electric service. Special consideration has been given in some cases where customers of good standing have needed temporary relief. Industrial and manufacturing customers who have become delinquent have been given temporary assistance by accepting notes payable at convenient times to the customer, with the stipulation of payment of current bills as they become due. The general plan and policy of this company (Poughkeepsie) during these times is to aid rather than retard the chances of any customer's recovery by extending credit as far as is practically possible.

Word-of-honor promises generally accepted

Extending added credit in times when all credit values shrivel would appear to demand greater rigidity in checking the credibility and the credit standing of delinquents. Actually, however, "where a consumer's past record of payments is good, we extend credit more liberally than we formerly did," is a typical reply and carries with it the implication that credit analysis has not been greatly tightened. One company did extend to other districts the credit history file which had been instituted previously only in three districts having a high credit risk. Even where the credit certificate plan has not been adopted as a formal procedure the customer's word-of-honor promises to pay when able have been accepted at their face value, provided the customer had no bad credit record. In general, however, it appears that the companies have ascertained more about the financial status of their delinquent customers than was the case when freer use of deposits and guarantees was available. The information is given by the customer with less restraint than in normal times. Delaying payment on the electric bill so as to have money for the filling station has, however, been an unforgivable sin with most companies unless the customer's automobile was essential to his business or general sustenance.

Co-ordination with welfare agencies has been a second problem and on this point an Atlantic seaboard company reports:

> Special consideration has been given in cases where the Emergency Relief Committee is interested in the customer's welfare and the accounting department is in constant touch with the welfare associations to co-operate with them in supplying service to those in need. The Welfare Association will pay us one month's bill and regardless of the condition of the account a 30-day extension is granted for payment. At the end of the 30-day period, if further help is necessary, the Welfare Association will pay another bill and another 30-day extension will be granted.

Commitment of the customer toward liquidating his delinquency has taken several forms, ranging from mere promises to the signing of notes and indorsement of credit certificates. Notes, however, are not prominent in the picture. The promises to pay have usually focussed on future bills with verbal or other commitment to catch up by monthly installments on the accrued arrearages. Meanwhile, it is stipulated and agreed that current bills will be paid, the use of the service being curtailed if necessary by the customer so that he can meet the magnitude of the bill when it is rendered.

Some will remain uncollectible

In attempting to separate the amount of the national delinquency from the shrinkage in cash receipts due to decreased consumption one encounters difficulty. However, arrearages in one system were said to be up 14 per cent over 1931, while the reduction in total sales revenue was about 5 per cent. A considerably larger pair of figures was reported from an industrial center where the overdue accounts multiplied four and one-half times while gross revenue was falling off 22.8 per cent (a com-

parison of April, 1929, and April, 1933, year totals). In another instance finality was given to the delinquency magnitudes by writing off 0.9 per cent in uncollectible bills in 1932 against 0.51 per cent in 1931.

In some respects a greater significance can be placed upon the complications arising from the delinquency than upon its present actual dollar magnitude or even upon its permanently uncollectible fraction. It has made necessary an increase in the magnitude of working capital required and this was an acute problem during the enforced bank holiday. It has materially increased the burdens on the accounting and collection departments and in many cases made an increase in staff necessary. It probably can be said safely too that delay in paying bills has been in a few cases a determining factor in forcing wage reductions, shortening the work-week, deferring dividends or creating a financial crisis for operating companies. It has certainly made more acute the shriveling of gross sales revenues and therefore done its share in practically all cases where increased incursions into surplus were found necessary.

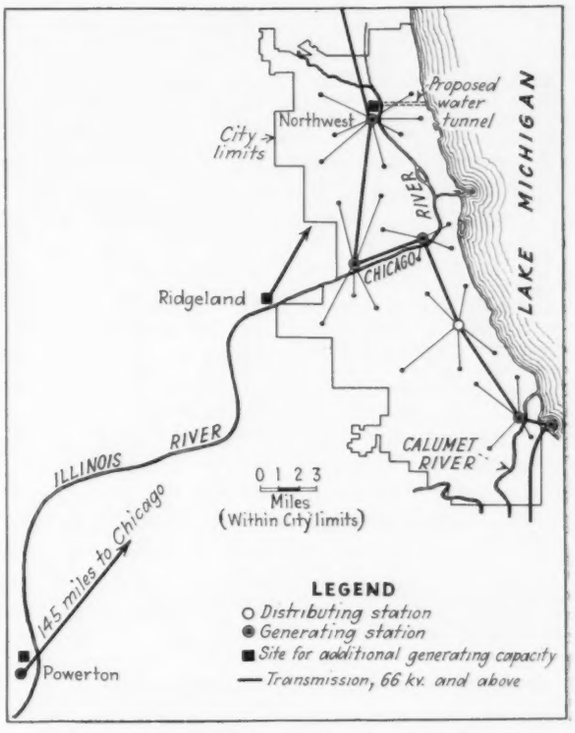
Gain in good will is certain

What of the future? Will a large portion of these unpaid accounts remain permanently uncollectible? The answer to this is not simple, because practice now varies as to labeling accounts uncollectible. Thus some companies put the account in this classification only after six months of effort following discontinuance of service has failed to bring in the money due. Since the delinquency agreements instituted during the last year or so have served to keep the customer connected and using the service the criterion of collectibility is a matter of the future. Poughkeepsie sets up a 50 per cent reserve against all accounts to which its credit extension plan has been applied. The status is reviewed monthly and the 50 per cent ratio then adjusted. On the whole, it appears that the consensus is that from 5 to 15 per cent of the recent delinquent accounts will remain unpaid. Expressed in terms of gross revenue this means a loss of the order of 1 to 1½ per cent. This range of figures is 2½ to four times the loss by default in normal years.

Any gain in good will derivable from the broad and tolerant methods of meeting customers' financial difficulties is so intangible as not to be reduced to quantitative statement. Invariably, however, the companies report that the reaction from those who have been helped has been most gratifying. Many spontaneous letters have come from them expressing their profound appreciation. Those companies, like Hartford, which made broad public announcement of their plan to extend credit in case of distress received many letters from those who were in no distress at the moment telling how well they thought of a company which would so humanely do its bit in tiding over those who were. Several companies state freely that they feel they will be well repaid in better public relations as a result of what they have been doing with the delinquencies. In this connection it should not be overlooked that the help was extended to many people of former means who wield an influence in their community and to many more others of lesser means who nevertheless form the backbone and core of conscientious American integrity and thrift. Their allegiance to their utilities will help offset the blind and selfish drives of reformers and agitators to whom humanity means not a virtue but merely a mass to be exploited politically.

Plant Location in Relation to Coal, Water and Electric Load

By T. G. LeCLAIR*
Development Engineer
Commonwealth Edison Company, Chicago



Most economical generation is at load center
Load is at Northwest, cheapest coal at Powerton and water directly available at Ridgeland.

THREE essential elements of bulk electricity supply system to a metropolitan area are fuel, cooling water and electric load. The variations in location and availability of these elements are largely responsible for the different fundamental plans of supply to the large cities in the United States.

Rarely indeed are these elements found at one location. Coal is seldom to be found near the load center. It is common practice and usually most economical to ship coal to stations near the load and transmit electricity from there. Several careful comparisons have shown that if the distance is great coal can be shipped more cheaply and safely than the same energy in the form of electricity. For this reason mine-mouth generation has lost its popularity as a topic for newspaper stories.

Four hundred pounds of cooling water are required per pound of coal for steam generation, so it has quite naturally been taken for granted that the generating station must be located at the water's edge. A sound economic analysis may show that, under some conditions, pumping water to a station at the load center is cheaper than transmitting power from a station at an adequate water supply.

The accompanying map and tabulations show that in

**Abstract of paper submitted for McGraw prize, 1933.*

Table I—Less Investment to Pump Condensing Water than Transmit Kilowatts

Investment to provide 300,000 kw. generating capacity to the Northwest 12,000-volt bus exclusive of those items which will not be affected by location of the generators.

	Location of Generators		
	Northwest	Ridgeland	Powerton
Generating capacity: 300,000 kw. plus capacity for losses, kw	312,000	307,500	330,000
3 generators at $100 per kw. including building	$31,200,000	$30,750,000	$33,000,000
Extra pumping equipment	300,000	.....	.....
1 16-ft. double tunnel 4 miles with one crib	4,000,000	.....	.....
3 step-down transformers 120,000 kva. each, 66/12 kv. with regulators	.....	1,200,000	1,200,000
3 66-kv. underground lines with conduit, each 14 miles, 120,000 kva	.....	5,700,000	5,700,000
step-up transformers with switches 120,000 kva. each, 12/69 kv., no regulators	.....	1,050,000	.....
3 step-down transformers, three-winding 120,000 kva. each, with regulators and 66-kv. switches	.....	.....	2,100,000
50,000-kva. condensers and switches	.....	.....	1,050,000
2 220-kv. terminals, seven switches each	.....	.....	850,000
3 step-up transformers 130,000 kva. each, 22/230 kv. with regulators and switches (low tension)	.....	.....	1,500,000
2 220-kv. lines 145 miles long	.....	.....	9,000,000
	$35,500,000	$38,700,000	$54,400,000
Excess over Northwest location	.....	3,200,000	18,900,000

Table II—Higher Annual Cost for Cables than for Water Tunnel

Total annual costs to provide 300,000 kw. capacity to the Northwest 12,000-volt bus. Accurate as to differences in totals only as each item represents only those parts of the total generating cost which might vary with different locations of the generators.

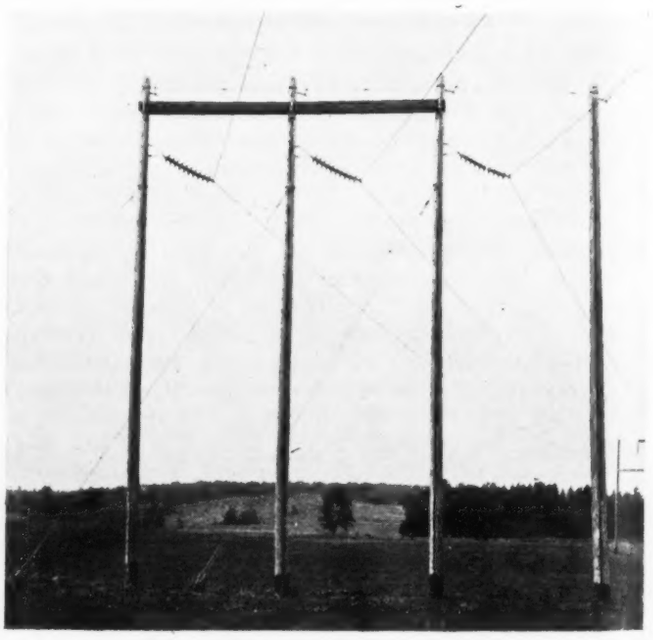
	Location of Generators		
	Northwest	Ridgeland	Powerton
Kw.-hr. delivered in millions at 60 per cent load factor	1,600	1,600	1,600
Kw.-hr. losses in millions at corresponding load factor	50	30	160
	1,650	1,630	1,760
Coal cost at 2.1-2.1 and 1.75 mills per kw.-hr	$3,450,000	$3,400,000	$3,050,000
Other production costs	850,000	850,000	850,000
Fixed charges (12½ per cent of Table I totals)	4,450,000	4,850,000	6,800,000
Total annual cost	$8,750,000	$9,100,000	$10,700,000
Excess over Northwest location	.....	350,000	1,950,000

one instance in Chicago it is cheaper to install additional generating capacity at the Northwest load center and dig 4 miles of double rock tunnel to Lake Michigan rather than to build 14 miles of underground transmission to Ridgeland or a greater length of overhead transmission to Powerton. In the illustration the cost balance in favor of the generators at the load center applies where additional transmission lines are required for all the additional load, but does not apply in case of the existing installations where the transmission lines between stations were installed primarily for intermediate load and their use for bulk power transmission is incidental.

In this case locating the generators at the load center is not only more economical but more reliable, as a solid rock water tunnel is not subject to external damage, as are the transmission lines, and is practically proof against interruption. In addition to the other advantages, there is still another possible economy in the load center location. This is that the water pumped from the lake may not have to be returned to the lake, but could be discharged into the city water system. The only real objection to this scheme is the increase in temperature of the water after passing through the condensers. This argument would have little force during the winter months and in summer would not be important if the volume of water discharged from the condensers is only a small part of the total demand of the water supply system.

The comparison shows that, in choosing the location for a generating plant, serious consideration should be given to the economics of transporting cooling water as well as coal or electricity.

Saving Material in Line-Angle Construction



In the construction of a wood-pole H-frame line interconnecting the Central Maine Power Company and Cumberland County Power & Light systems the typical angle in the line was designed as shown to economize material without sacrificing strength. At the turn the 110-kv. circuit comprising the tie is installed with ten-disk pull-off insulators with double attachments to the poles. The tension created by the change in conductor direction is cared for by short guys. The line has four overhead ground wires earthed at each pole. In the intermediate spans the conductors are carried by suspension insulators of eight disks from a single crossarm supported by the two inner uprights of the H-frame, leaving the two outer poles to carry two outside ground wires. At the turn it was unnecessary even to guy the outside right-hand pole, the strain of the ground wire turn being transmitted to the other three poles by lateral ties at the tops. To offset the use of the guy wires the angle structure does away with two of the three horizontal crosspieces required in the intermediate span structures.

Heat From Lighting as an Air-Conditioning Load

By WALTER STURROCK and J. H. WALKER
General Electric Company *Detroit Edison Company**

IN GENERAL the comparatively small amount of heat from artificial lighting systems in the past has been of very little consequence as far as heating a building is concerned. At present, however, there is a trend in certain classes of interiors toward the use of illumination which requires three, four or five times the wattage capacity previously used. These higher wattage capacities create a corresponding increase in the heat generated. Also, there is a trend toward the use of artificial cooling systems to provide during the summer months a greater degree of comfort for the occupants of stores, offices, theaters and other interiors. These trends indicate that in the future more consideration will be given to the heat generated by a lighting system.

When a gas-filled incandescent lamp of the 300- to 500-watt size is operated at normal voltage its energy distribution is about as follows:

	Per Cent
Light	11
Heat as invisible radiation in the infra-red region	70
Heat which is conducted away from the filament through the filament supports and leads	3
Heat dissipated by gas convection and conduction	8
Heat radiated by the bulb	8

Hence from a clear-bulb, gas-filled lamp about 90 per cent of the total energy is in radiant form, which includes all of it except that dissipated by the filament supports and leads and by the gas.

One of the most generally used types of lighting equipment is the white glass-inclosing globe. If a lamp is placed in one of these units it is estimated that on the average the globe will absorb something of the order of 15 to 25 per cent of the radiant energy reaching it from the lamp filament and nearly 100 per cent of that reaching it from the bulb. Hence with 81 per cent of the total energy generated by the filament of a lamp being set free in the form of radiant energy, then when the lamp bulb is placed in a white glass-inclosing globe there will be something of the order of 60 to 65 per cent of the energy dissipated in radiant form. The remaining 35 to 40 per cent of the energy is dissipated from the lamp and inclosing globe by conduction and convection. Theoretically, it is only this heat that can be removed from the lighting unit by a circulating air system and some attention has been given to this possibility in order to reduce the heating effect in a room.

If no attempt is made to intercept and carry away any of the heat generated by the lamp the question arises as to what portion of it is actually effective in raising the room temperature or in augmenting the load on the cooling system in an artificially cooled building. At first thought it would appear that the heat equivalent of the entire energy input to the lamps, amounting to 3.415 British thermal units per watt hour, must inevitably be regarded as being effective. In fact, that assumption is ordinarily made in the engineering calculations for a cooling system. A close examination of the matter, however, reveals several facts that should modify such an assumption.

Not all of the radiant heat from the lamps becomes a load upon the cooling system, however. A portion of it passes through the windows to the out-of-doors and some of that which strikes the walls, ceiling and floor is absorbed by the building structure and partially dissipated during the cooler night hours.

A large effect of the ceiling height is due to stratification of the air. The heat from the lamps which is intercepted by the glassware surrounding them, amounting to 35 or 40 per cent of the total energy of the lamps, goes largely toward heating up the air surrounding the lamp and forms near the ceiling a stratum of very warm air. If this stratification is not disturbed by forced air currents it will not affect the comfort of the occupants below, especially if the room has a high ceiling. In a high-ceilinged room, even with artificial cooling, the heat from the lamps may not, however, be entirely absorbed by the cooling system.

More than half of lighting is a cooling load

In the judgment of the authors from 50 to 90 per cent of the lighting energy becomes a part of the cooling load, depending upon the particular conditions of the installation. The results of investigations on actual room temperature rises in uncooled rooms, due to artificial lighting, throw additional light on the problem.

From the studies made it was found that in the typical closed room with no artificial or natural ventilation the temperature rise during the seven-hour period due to the lighting system is approximately $\frac{3}{4}$ deg. F. for each watt per square foot of electrical energy consumed. On the other hand, with the windows and transom open for natural ventilation on typical summer days the temperature rise is of the order of 0.22 deg. F. for each watt per square foot of lighting capacity. The lighting equipment consisted of four open-top, semi-indirect units at the ceiling supplemented by indirect floor standards to provide the higher capacities. Approximately half the total rise occurred during the first hour.

Outdoor temperature had very little effect on the test room temperature rise during the seven-hour period when the windows were closed. With two watts per square foot the temperature rise in the closed room is $1\frac{1}{2}$ deg. F., while in the ventilated room during the summer time it is only about $\frac{1}{2}$ deg. F.

In the accompanying table is shown the relative importance of the several items which constitute the cool-

**Excerpts from paper No. 3 presented before 27th annual convention of Illuminating Engineering Society, Lake Delavan, Wis., August 28-31, 1933.*

ing load in different kinds of buildings. These are figures which were arrived at in the process of designing the cooling systems. The first building in the table is a sales office of an electrical company. The show windows are not partitioned off from the salesroom itself and the heat from the high-intensity window lighting must therefore become a load on the cooling system. The building is so shaded by adjacent buildings that the sun never shines through the windows and the external load is therefore small. This combination of conditions causes the lighting to be 50 per cent of the total calculated load.

At the other extreme we have a theater, in which the lighting is almost negligible as a source of cooling load. The load imposed by the occupants and by the introduction of outside air constitutes most of the total. In the case of the office building the use of awnings eliminates the solar radiation through the windows as a source of load to the cooling system, thus increasing the relative effects of the lighting and other factors.

Lighting is responsible for a part of the cooling load, varying between 5 and 50 per cent of the total, depending upon the type of building. Recognition of this fact suggests the elimination of the heating effect from lighting units in some manner, such as diverting the heat directly from the source into a ventilating duct, where it will be dispensed with or utilized as may be desired.

Separate ventilation not always feasible

Experiments indicate that with forced circulation of air through the lighting fixture the maximum amount of the total heat which could be removed would be about one-third of the total energy generated. The question naturally arises as to whether an auxiliary system of ventilation for the lighting fixtures would be justified on economic grounds in a building which is artificially cooled.

Let us take as an example an office building located in Detroit having the following characteristics:

Height	15 stories
Total net office floor area	102,200 sq.ft.
Capacity of cooling system	300 tons of refrigeration
Type of cooling system	CO_2 compression system
Hours operation per year	1,000
Initial cost of cooling system	$160,800
Annual operating cost:	
Electricity at 1½ cents per kw.-hr.	$6,130
Water at 40 cents per M cu.ft.	1,920
Total	$8,050

Let us assume that 35 per cent of the heat from the lamps would be eliminated by the auxiliary ventilation and that, with no awnings on the building, the heat from the lamps would be responsible for 26 per cent (see table) of the capacity of the cooling system and for the same fraction of its operating cost. If, then, we remove 35 per cent of the lamp heat the size of the cooling system and the cost of operation would be reduced by 9.1 per cent.

The operating cost would thus be reduced by only $732 per year. The initial installation cost of equipment would not be reduced in proportion to the possible 9.1 per cent reduction in its capacity. Hence the total saving in cost of equipment and installation would be considerably less than 9.1 per cent of $160,800, or $14,600. The foregoing total savings in cost would probably not be sufficient to pay for the rather complicated system of lighting fixture ventilation which would be required.

Relative Importance of Factors Affecting the Cooling Load in Different Classes of Interiors

Type of Interior	Lighting Watts per Sq. Ft. of Floor Area: Installed	Lighting Watts per Sq. Ft. of Floor Area: Assumed in Use	Relative Factors in Per Cent: Lighting	Relative Factors in Per Cent: Solar Radiation through Windows	Relative Factors in Per Cent: Heat Conducted through Walls and Windows	Relative Factors in Per Cent: Infiltration of Outside Air	Relative Factors in Per Cent: Occupants*
†Sales office of electrical company with show-window lighting	6.9	4.4	50	0	2	46	2
Office building:							
with awnings	7.0	3.1	37	0	11	37	15
without awnings	7.0	3.1	26	33	4	26	11
Cafeteria	0.9	0.9	9	0	6	28	54
Theater	...	2.6	5	0	5	45	45
†Research Laboratory	2.0	0.7	8.6	..	..	..	..

*Includes dehumidifying load. †Cooling system is in actual operation.

Therefore, it appears that removal of the heat from lamps by forced ventilation of the luminaires is justified only when a very large amount of wattage is concentrated so that the ventilation can be done in a relatively simple way or when considerations of comfort in an uncooled building are paramount. Examples of such cases are the high-intensity lighting in show windows, motion-picture studios and hospital operating rooms.

Heat-absorbing glass advocated

For lighting systems employing the usual types of luminaires placed below the ceiling it is mechanically possible to install a ventilating system with air ducts to the units so that a maximum of about one-third the total generated energy can be removed. With the so-called "built-in" types of lighting equipment, where a free circulation of air is provided around the lamp, the amount of heat carried off will depend upon the heat transmission characteristic of the glass through which the light enters the room. If this glass is of the heat-resisting, heat-absorbing type and is itself cooled, then at least twice as much can be removed by the ventilating air as found possible from the usual types of lighting units suspended below the ceiling.

Buildings Artificially Cooled—In artificially cooled buildings it is estimated that from 50 to 90 per cent of the total energy generated by the lighting system will eventually become a burden on the cooling load unless this energy or a part of it can be carried off direct from its source. Inasmuch, however, as a maximum of only one-third the total energy can be removed from the usual types of lighting equipment, it is the opinion of the authors that the cost of an auxiliary ventilating system for this purpose would not in general be economically justified for the present standards of lighting whose requirements seldom exceed 5 watts per square foot per floor area. In other words, for these general interiors it would be less costly to provide sufficient cooling capacity to offset the heat generated by the lamps as well as that from other sources.

On the other hand, for interiors where high levels of illumination are used which require 10, 15 or more watts per square foot careful consideration should be given to a separate ventilating system which not only carries off the readily removable one-third of the heat energy, but also makes use of heat-resisting glass to intercept a considerable portion of the radiant energy.

Buildings Not Artificially Cooled—The rise in tem-

perature is not serious for present general standards of illumination, but is of considerable concern when high levels are used requiring 15 to 20 watts per square foot. In the latter case the temperature rise may be of the order of 10 to 15 deg. F. Most interiors have natural ventilation obtained from outside windows and doors, in which case the temperature rise is more of the order of $\frac{1}{5}$ deg. F. for each watt per square foot of electrical energy consumed.

In both the closed room and the one with the windows open there is always a large amount of radiant energy for the 15, 20 or higher wattage per square foot installations. Although this radiant energy does not ordinarily register its presence on the thermometer, yet it creates a feeling of warmth when absorbed by the human body. For all interiors where the occupants are working under high-wattage capacities more consideration must be given to dispensing with the radiant energy.

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Systematized Safety Interlocks for Basic Station Diagrams

By M. M. SAMUELS

RECENT discussions have finally boiled down all connection schemes to a few basic diagrams, and it is now fairly well established that these few basic diagrams are practically the only ones conceivable and that all other diagrams are built up from these basic ones. Hence it is now possible to establish a systematization of safety interlocks for these basic diagrams that may be termed "intracircuit interlocks," leaving out for the present all intercircuit interlocks as special. At a later date it will no doubt be possible to go a step further and systematize also the intercircuit interlocks to a great extent.

What are interlocks for?

A. Life and health protection:

I. To prevent an operation that may endanger the life or limb of the person who performs the operation.

II. To prevent an operation that may endanger the life and limb of another operator, lineman, repairman, inspector, etc.

B. Property protection:

III. To prevent an operation that may result in property damage.

IV. To prevent an operation that may bring about an unintentional interruption of service.

We are here concerned primarily with a diagrammatic study of the problem and not with the various methods of the physical execution of interlocks. But it may be well to mention in passing that physically there are three distinct types of interlocks.

V. Mechanical interlocks, consisting of rods or other mechanism parts so interconnecting two or more mechanisms that the operation of one or more parts depends on the position of one or more of the other parts.

VI. Electrical interlocks, whereby the control circuits of two or more switches or other devices are so interconnected that the operation of one or more depends on the relative electrical status of one or more of the others.

VII. Key interlocks, wherein a mechanism cannot be operated in a certain way (for instance, either for closing or for opening a switch as may be required), unless a key is inserted somewhere in the mechanism, and that this key is located in the mechanism of another piece of equipment and cannot be removed therefrom unless this other piece of equipment is in a desired position (another switch either closed or open, as may be required).

Returning to the diagrammatic study of the problem, the most important distinction can be established:

VIII. Interlocks preventing a switch from being opened except under certain desired conditions.

IX. Interlocks preventing a switch from being closed except under certain desired conditions.

Referring to VIII, while there may be cases in which it is desirable to prevent the opening of a breaker under certain circumstances, and while in the case of lockout relays it is very important to prevent the breaker of lower rupturing capacity from opening before the one of higher rupturing capacity opens, such cases may be considered special, and as a general proposition breakers should be free to trip or to be opened by hand quickly without being hindered by interlocks. Except for the case of lockout relays, the faulty opening of a breaker does not fall in classification I or III. Only IV is possible, and while this is important, it is more important to allow a breaker to trip out as quickly as possible in case of trouble. For disconnects, however, it is always important to prevent them from being opened under load. So that as regards VIII we have a definite, important distinction between breaker and disconnects.

For IX the conditions are practically the same for breakers and disconnects. Here it is important not to close either a breaker or a disconnect unless all conditions of the circuit are just right for the closing. Even though we are here restricted to intracircuit interlocks, it may not be amiss to mention that the great majority of intercircuit interlocks are also for the purpose of preventing the closing of a switch in one circuit unless certain conditions are fulfilled in one or more other circuits.

There are three outstanding reasons for preventing a switch from closing:

X. For circuits requiring synchronizing, to prevent closing a switch before establishing synchronism.

XI. For all circuits to prevent energizing part of a circuit upon which some one may be engaged in inspecting or repairing.

XII. In a production process to prevent a motor from starting before the production process is ready for it.

The above represents a complete systematic presentation of all principles involved in interlocks and a systematization and simplified digest of all the discussions that have taken place on the subject.

The accompanying illustrations represent the basic diagrams established in a discussion of the station design subcommittee of the electrical apparatus committee of the N.E.L.A. at Atlanta, Ga., December, 1931. For all these circuits, if synchronizing is required, the breaker should be so interlocked with the synchronizing switch that the breaker cannot be closed unless the synchronizing switch is in proper position for synchronizing. There

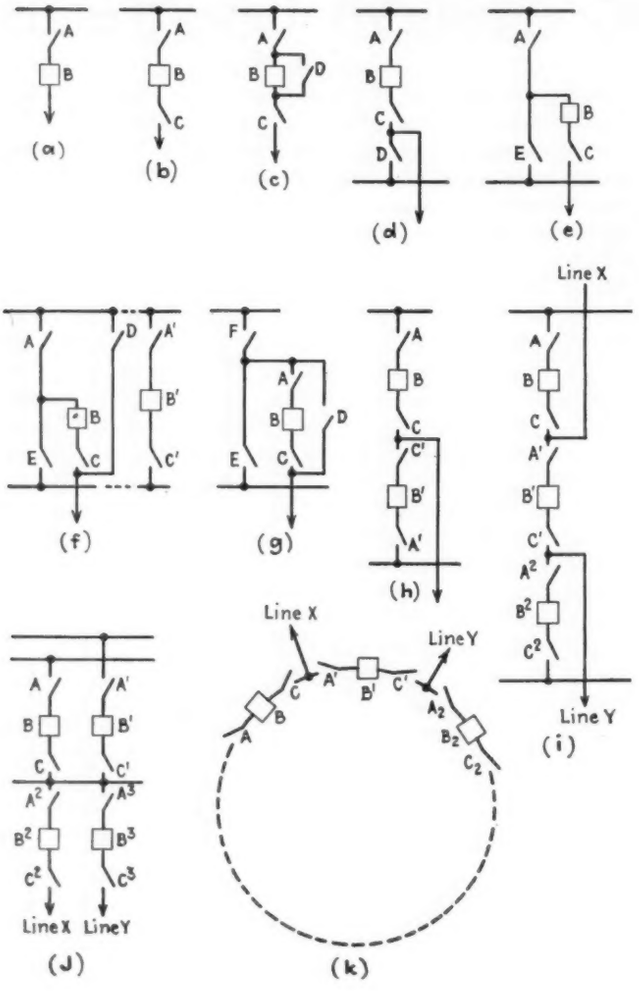
will be only a few cases in which it will be practical to so interlock the breaker that it cannot close unless actual synchronism is established. It is done only in cases of automatic synchronizing. For all cases of manual synchronizing it is customary only to prevent the operator from forgetting to synchronize altogether by interlocking the breaker with the synchronizing switch, but then the operator is depended upon to establish synchronism before he closes the breaker. This is not foolproof, but is a good reminder difficult to overlook. In most cases reminders difficult to overlook are sufficient and in some cases better than foolproof arrangements, because operators as a rule are not foolish.

Having thus eliminated synchronizing, the various interlocks can now be simply tabulated for the various basic diagrams shown as indicated in their captions.

It is not recommended that all the interlocks shown be employed in all cases. In fact, there are a great many cases where interlocks have not been used at all and where no trouble whatever has been reported due to their absence. What is intended here is merely to give the maximum number of possible intracircuit interlocks so that every one can check them in each case and decide which, if any, interlocks are required in the particular case.

The diagram alone is not sufficient for a study of the required interlocks; the physical arrangement, accessibility, etc., of the switchgear structure must also be con-

Appropriate interlock combinations for basic station switching schemes



(a) A not to open when B is closed.
A not to close when some one is working on B.
Either A or B not to close when some one is working the circuit.

(b) A and C not to open when B is closed.
A and C not to close when some one is working on B.
Either A, B or C not to close when some one is working on the line.

(c) A and C not to open when B is closed.
A and C not to close when some is working on B.
D not to open unless A, B and C are all closed.
D and either A, B or C not to close when some one is working on the line.

(d) A and C not to open when B is closed.
A and C not to close when some one is working on B.
Either A, B or C not to close when some one is working on the line.

(e) A, C and E not to open when B is closed.
A, C and E not to close when some one is working on B.
Either A and E or B or C not to close when some one is working on the line.

Note: It is sometimes important to so interlock A and E that they cannot both be closed at one time, and sometimes it is essential to be able to have both closed at one time. When synchronizing is being done from circuit to bus instead of circuit to circuit this diagram often calls for special synchronizing interlock arrangements.

(f) A, C and E not to open when B is closed.
A, C and E not to close when some one is working on E.
A^1, C^1 and D not to open when B^1 is closed.
A^1 and C^1 not to close when some one is working on B^1.
A and E and D not to close when some one is working on the line.

(g) A, C, E and F not to open when B is closed.
A and C not to close when some one is working on B.
D not to open unless A, B and C are all closed.
E and F or C and D not to close when some one is working on the line.

(h) A and C not to open when B is closed.
A and C not to close when some one is working on B.
A^1 and C^1 not to open when B^1 is closed.
A^1 and C^1 not to close when some one is working on B^1.
C and C^1 not to close when some one is working on the line.

Note: Sometimes it is advisable to interlock B and B^1 so that the two cannot be closed or open at the same time.

(i) A and C not to open when B is closed.
A^1 and C^1 not to open when B^1 is closed.
A^2 and C^2 not to open when B^2 is closed.
A and C not to close when some one is working on B.
A^1 and C^1 not to close when some one is working on B^1.
A^2 and C^2 not to close when some one is working on B^2.
A, B or C and A^1, B^1 or C^1 not to close when some one is working on line X.
A^1, B^1 or C^1 and A^2, B^2 or C^2 not to close when some one is working on line Y.

(j) A and C not to open when B is closed.
A and C not to close when some one is working on B.
Same interlocks for B^1, B^2 and B^3 with their respective disconnects.
A^3, B^3 or C^3 not to close when some one is working on line X.
A^3, B^3 or C^3 not to close when some one is working on line Y.

(k) A and C not to open when B is closed.
A and C not to close when some one is working on B.
Same interlocks for each breaker of the ring with its respective disconnects.
C and A^1 not to close when some one is working on line X.
C^1 and A^2 not to close when some one is working on line Y.
Same interlocks for the two sets of disconnects of each line.

sidered. There are many cases in which a man working on a breaker cannot see all the switches, the closing of which may energize one or the other side of the breaker, and in such cases it is quite a relief if he knows that he locked all these switches open and has the key on his belt. Many cubicle designs show arrangements in which one set of disconnects is operated from the front and another set from the rear. This is decidedly an incompetent design; all disconnects should be operated from the same side from which the breaker is made accessible. In the case of stick switches it is difficult to interlock the switches themselves and for cell or cubicle construction the attempt is often made to interlock the door through which the switches are operated. Aside from the fact that this is only practical for reasonably low voltages, and from the further fact that more than one set is often accessible through the same door, there is always the danger of operating two switches and forgetting the third one. This is one of the many reasons why stick switches should not be used. There really should be some regulation requiring all poles of a circuit to be operated simultaneously in all cases, or perhaps even all disconnects on both sides of the breaker simultaneously. This involves no particular difficulty and there is no reason why it should not be universally used.

The interlocks mentioned above for protecting a man working on a line can only be accomplished by means of keys. The lineman could then lock all the respective switches open and take the key with him. This is only mentioned as a possibility, because it has actually been done in some cases. But it is not generally practical, principally because most circuits can be energized from more than one station, and even if it were practical the lineman would not depend exclusively on it; he would continue using his ground chain. For protecting a man working a circuit grounding switches are becoming more and more popular and will no doubt soon be in universal use, but even then the wise lineman will continue using the grounding chain or similar grounding devices.

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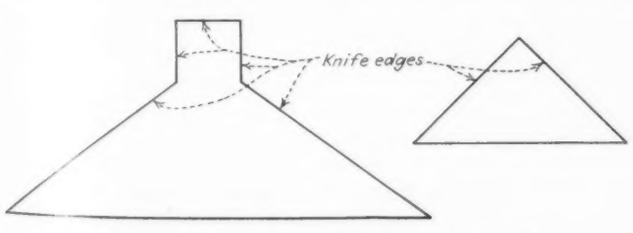
Template Used for Pointing Paper in Recording Instruments

By S. L. LINDEMAN

Meter Department,
Central Illinois Electric & Gas Company, Rockford

Scissors are natural tools for tailors, dressmakers and editors, but they have no place in the meterman's tool kit. For such purposes as scissors might be put to in meter work, notably in shaping the paper of instrument record rolls for insertion into the arbors of winding spindles, there is in use in the meter department of the Central Illinois Electric & Gas Company a couple of flat sheet metal templates. The templates are in the shape of an isosceles triangle with the sides of the angle opposite the base somewhat sharpened. The template is laid on the paper, point toward the end, and the paper then torn off, leaving the end ready for insertion into the slot of the spindle arbor. This simple tool has been found to be an effective time saver in starting charts in Westinghouse recording voltmeter and RA demand meters.



Left—Template used on RA demand meter charts. Right—On charts for recording voltmeters

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READERS' FORUM

Transformer Fire Hazards

To the Editor of the ELECTRICAL WORLD:

In the issue of the ELECTRICAL WORLD for July 22 there is an abstract of a report of experiments made to find satisfactory and economical means for extinguishing fires which may occur in conjunction with power transformers. In this abstract the "Inertaire" transformer, a product of the Westinghouse company, is classed with other types of transformers as a potential fire hazard. It is true that power transformers in general have the elements of fire hazard in their construction and are capable of throwing oil, burning or otherwise, at the time of trouble. That the Inertaire transformer is decidedly protected against such hazards, however, may be very clearly seen from a review of the fundamental theory of the Inertaire transformer and its actual service record over the past nine years.

The Inertaire transformer has its own supply of inert gas, which the report says is "ideal for internal fires." Without oxygen to support it, no fire can exist in the inert gas space of an Inertaire transformer and no explosion can be propagated in it. Again, the Inertaire transformer has a gas cushion which greatly reduces explosive pressures if some failure in the windings should arc the oil and set up an abnormal internal pressure. The Inertaire diaphragm relief device in conjunction with the cushioning effect of the inert gas is thoroughly effective in preventing any rupture of the tank or cover. Lastly, the condenser bushing is free from any tendency to produce fires, because it is unusually reliable, with its scientific grading of potential from line end to ground, and is free from oil hazard.

The effectiveness of the Inertaire transformer will be recognized when it is realized that in the past nine years in which Inertaire transformers have been in commercial use not a single fire and not a single explosion above the oil level have occurred in a transformer protected with Inertaire. Furthermore, with the exception of two cases in which wrong material used in the relief diaphragms caused rupture of the covers and the throwing of a slight amount of oil, no cases of damage to the transformer tanks nor the throwing of oil has occurred among the more than one thousand Inertaire transformers actually in service.

H. V. PUTMAN,
Engineering Manager.
Westinghouse Electric & Manufacturing Company,
Sharon, Pa.

BOOK REVIEWS

Power Sales

By Dean Taylor. Published by the McGraw-Hill Book Company, 330 West 42d Street, New York, N. Y. 206 pages. Price, $2.

Readers of ELECTRICAL WORLD who have followed the Dean Taylor series on the approach to power sales problems do not have to be introduced to this book, which embodies not only the articles which have been published but amplifications thereof and discussions of related topics. Some of the topics covered will be a sufficient reminder. Retaining existing customers; meeting Diesel competition; payment out of savings contracts; find the "no"-man first; when the odds are against you, and an approach to an untouched market. Not just one man's ideas are presented, but practices that have been found successful in various sections of the country. It is a book which should be particularly helpful to utility power salesmen at this time, when they must regain lost ground and develop new business.

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The Electrical Properties of Glass

By J. T. Littleton and G. W. Morey. Published by John Wiley & Sons, Inc., 440 Fifth Avenue, New York, N. Y. 184 pages, illustrated. Price, $3 plus postage.

Glass is one of the oldest materials used for electrical insulation. This test gives the data available on old and new glass and applies the dielectric theory to available experimental results. The use of glass for high-voltage insulation and insulators makes this work very valuable and opportune. The physical and chemical properties of glass are discussed, surface and volume conductivity studies are outlined and an especially good treatment is given to the dielectric properties of glass. Both dielectric data and knowledge are meager, but the authors have done a splendid job in bringing available data together for critical analysis and discussion.

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Electricity in Agriculture Handbook

Published by Rural Sales Bureau, Northwest Electric Light and Power Association, Portland, Ore. 71 pages, illustrated.

Two years of careful compilation effort by the Rural Sales Bureau of the Northwest E.L.&P.A. has produced a most comprehensive and usable handbook for farm electrification. It has performance data, power consumptions, over-all costs, technical data, apparatus characteristics and suggestions for installation and operation in the seven most promising agricultural usages for power. Bulletins of the Committee on the Relation of Electricity to Agriculture and the National Rural Electric Project have been incorporated or drawn upon for the concise, condensed and factual material that the electro-agricultural engineer needs in order that he may do an honest and competent application job. The following topics are treated under the sub-titles indicated: Dairying—cooling, sterilization, separators, milking machines. Water supply—quantities required, appropriate pumps, storage problems. Fruit farming—spraying, grading and washing, refrigeration, drying. Hay, grain and feed—chopping and ensilage cutting, grinding, elevating and hoisting, mixing. Irrigation wells and pumping—water requirements of crops, types and costs of pumping plants, costs of operation, how to dig wells and measure water. Poultry—poultry house lighting, incubation, brooding. Soil heating, farm wiring, motors and shop.

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Electron Tubes and Their Applications

By John H. Morecroft. Published by John Wiley & Sons, Inc., New York. 452 pages, illustrated. Price, $4.50.

A comprehensive book on the theory and applications of electron tubes for students and engineers. A discussion of matter, electronic emissions from matter, space charge and other fundamentals is followed by treatment of hot-cathode vacuum tubes, hot-cathode gas-filled tubes, special tubes, valves and their uses, triodes as amplifiers, oscillators, modulators and meters and applications of tubes to special uses. The book is well written and illustrated and mathematics are largely absent and replaced by characteristic curves and explanations of the physical phenomena.

This text is well done for the field it covers. It could well be enlarged to have more of the detail of practical applications to radio and industry, but it does give a comprehensive technical treatment of this new tool so that students and engineers can use and apply electron tubes intelligently. It is a welcome addition to the literature on tubes.

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Symmetrical Components

By Charles F. Wagner and R. D. Evans. Published by the McGraw-Hill Book Company, 330 West 42d Street, New York, N. Y. 437 pages, illustrated. Price, $5.

Unbalanced polyphase circuits were analyzed by necessarily cumbersome methods until C. L. Fortescue in 1918 propounded the procedure by which such systems could be resolved into symmetrical component systems of direct-, reverse- and non-sequence. Since then the authors of this book and others have been expanding the new technique and applying it to an increasing variety of machine, line and metering problems. The first book devoted exclusively to this subject, it is a complete treatise, so presented as to be a self-teach text for those who know conventional circuit theory for the balanced condition as well as for the senior or graduate student in the technical school.

Application of the method to determination of voltages and currents under unbalanced fault conditions on power lines is a major aim of the authors. It thus lays the foundation for analysis of relaying and protective measures to preserve continuity of service, stability of interconnections and limitation of fault damage to apparatus. Truly practical flavor is introduced by an unusual number of working illustrations and numerical problems; there is also a large amount of data in the form of typical constants for transformers, conductors, induction motors, phase balancers, etc. Several chapters are devoted to the measurement of sequence quantities and others to the problems of polyphase unbalance from single-phase railway electrification, furnace loads and abnormal operation of induction motors.

Men of the Industry

H. B. Bryans New President of Pennsylvania Association

Henry B. Bryans, vice-president of the Philadelphia Electric Company in charge of operations, was elected president of the Pennsylvania Electric Association at the meeting held last week at Bedford Springs. Mr. Bryans has been prominently identified with the public utility industry in Pennsylvania

for a number of years, his connections including association with the United Gas Improvement Company, the Counties Gas & Electric Company and the Philadelphia Electric Company in various operating and executive positions. It was in 1929 that he was elected to a vice-presidency with the Philadelphia utility. Earlier in his career he spent some time in the employ of the Kansas City Gas Company and the Fulton County Gas & Electric Company at Gloversville, N. Y.

Mr. Bryans has engaged in various activities in the association he has been selected to head and also in the old National Electric Light Association and the Pennsylvania Gas Association. He is a member of the American Institute of Electrical Engineers and of numerous civic clubs in Philadelphia and Norristown.

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C. H. Locher has been named as consultant on the Norris Dam construction. He and Dr. A. E. Morgan, chairman of the Tennessee Valley Authority, visited the dam site recently and conferred on construction methods.

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Walter V. Read, after eleven years as specialist on electrolysis and general corrosion problems with the headquarters organization of the American Telephone & Telegraph Company, New York, has recently established himself independently as an engineer and consultant in this field, with offices in New York.

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E. G. Crawford Becomes Head of Cleveland Electric

At a meeting of the board of directors of the Cleveland Electric Illuminating Company held last week Eben G. Crawford was elected president, a director and a member of the executive committee of the board. Mr. Crawford, formerly vice-president and secretary of the company, succeeds the late Robert Lindsay, with whom he was closely associated in the management of the company for twelve years. During the long illness of Mr. Lindsay, which terminated in his death last month, Mr. Crawford was the chief executive officer of the company.

Prior to his association with the Cleveland utility Mr. Crawford was engaged for thirteen years in banking and investment banking. It was in 1921 that he was elected secretary of the Illuminating company. During twelve years' close association with Robert Lindsay in the management of the Cleveland properties Mr. Crawford handled $80,000,000 of new financing required for refunding and for the building of power plants, transmission lines, substations and other facilities needed to meet increased demand for electricity in the Greater Cleveland district. Early this year Mr. Crawford

was elected vice-president of the company and in this capacity he worked out and put into effect the general rate reductions by the company April 1.

Since 1924 Mr. Crawford has been president of the Illuminating Securities Company. He also is president of another Illuminating subsidiary, the Power & Light Building Company, and serves as a member of the board of directors of the National City Bank.

Bond & Share Executives Assume New Duties

W. H. Burke, president and general manager of the Minnesota Power & Light Company, Duluth, and of the Superior Water, Light & Power Company, Superior, Wis., has resigned to become administrative assistant to the chief operating executive of the Electric Bond & Share Company, New York. M. L. Hibbard, president and general manager of Idaho Power Company, who for a short time in 1928 was associated with the Duluth company, will succeed Mr. Burke. K. M. Robinson, for the past two years assistant general manager Idaho Power Company, was elected by the board of directors to the position of vice-president and general manager to succeed Mr. Hibbard.

Mr. Burke was connected with the Stone & Webster organization before identifying himself with Electric Bond & Share interests in 1929, having served in engineering capacities in various sections of the country, including Massachusetts, Texas, Michigan and Iowa. Mr. Hibbard joined the Idaho Power Company in 1928 as assistant general manager under W. R. Putnam, then vice-president and general manager of that company. When Mr. Putnam left Idaho to go with the Electric Bond & Share Company in New York, in March, 1929, Mr. Hibbard succeeded him in that position. In January of this year he was elected president of the company (Electrical World, January 28, page 143).

K. M. Robinson obtained all his experience in the light and power field with the Idaho Power Company and its predecessor. He was brought to the company's general office in an executive capacity in 1929.

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OBITUARY

George C. Ward

George C. Ward, president of the Southern California Edison Company, Ltd., and one of the most distinguished figures in American engineering and electric utility operation, died September 11 at the Good Samaritan Hospital, Los Angeles, in his seventy-first year. Builder of the Edison company's hydroelectric generating system in the High Sierras of central California, Mr. Ward contributed substantially to the physical and economic growth of southern California. He personally, in 1911, made the first reconnaissance of the hydroelectric power sources of the High Sierras, and under his direction the initial undertaking of transmitting electric power from Big Creek on the San Joaquin River to southern California

was successfully completed and new transmission methods were developed which are now standard practice throughout the world.

Mr. Ward became a member of the Edison company executive staff in 1917, a date which marks the beginning of his intimate association with the late John B. Miller and the late Russell H. Ballard, former chairman and former president of the company, respectively. Since 1911 he had been vice-president of the Pacific Light & Power Company, a Huntington organization. With the consolidation of the Edison company and Pacific Light in 1917 to form the Southern California Edison Company Mr. Ward became vice-president in charge of construction. He continued in that capacity throughout the duration

of the High Sierras development work and the beginning of the company's extensive development of its Long Beach steam-electric station. In 1928 he was appointed executive vice-president of the company, continuing his personal direction of construction activities. He became senior vice-president in 1931 and was appointed to the presidency last October, succeeding to the office made vacant by the death of Mr. Ballard. A graduate of Phillips Academy at Andover, Mass., Mr. Ward obtained his early engineering experience in the state of New York.

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HENRY W. DARLING, formerly treasurer and vice-president of the General Electric Company, died at his home in Schenectady, September 4, in his eighty-seventh year. Mr. Darling was treasurer of General Electric for more than thirty years. He resigned late in 1924. At the time of his resignation, which was due to his advanced age, the board of directors elected him a vice-president and conferred on him the honorary title of treasurer emeritus. Before becoming identified with the electrical industry, in the early nineties, Mr. Darling had established himself in the financial field in Canada. Mr. Darling was a native of Edinburgh, Scotland.

New Equipment Available

Portable A.C. Testing Set

Portable a.c. testing set, known as the "Industrial Analyzer," suitable for testing household electrical appliances and industrial apparatus and motors up to 100 hp., 440 volts, is announced by the Westinghouse Electric & Manufacturing Company. Capable of making complete tests up to 125 amp., 500 volts a.c., the analyzer is in reality a miniature portable three-phase switchboard panel in a carrying case complete with all necessary switching equipment, transformers and resistors. The unit contains a triple scale ammeter 0-150, 0-300 and 0-600 volts, a polyphase wattmeter with three scales for the above voltage and current ranges and a polyphase power-factor meter with 10-100-80 scale to operate on the above voltages and currents. The instruments are of a newly designed miniature type with standard size mechanism, having high overload capacity and low energy consumption. The scales of the instruments are 3½ in. long.

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Street Light Maintenance

With the inauguration of fixed units in street lighting came a demand for more flexible equipment than the tower truck as a means of servicing the lamps. The "Giraffe" ladder was developed as an answer to this demand by Charles A. Bay, Morristown, N. J. It is a triangular truss construction, a smaller triangular ladder telescoping a larger one, so designed to jack-knife into running position.

An indicating light signals the operator when the ladder is fully anchored and safe to climb. When the ladder is in position the car cannot be started. The ladder may be swung in vertical, also horizontal plane, or may be elevated either parallel with center line of truck or at right angles to it, thus making it possible to reach a lamp, even though a car be parked between the truck and pole.

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Air-Cooled Compressor

Air compressors requiring no cooling water and which are accordingly particularly adapted to certain applications where water is scarce, costly or objectionable have been announced by the Ingersoll-Rand Company, New York. The new machine is called the "Motor-compressor" and, as the name implies, it has a built-in motor. The motor rotor is carried on the compressor shaft and the motor frame is bolted directly to the compressor crankcase.

Some of the advantages claimed for these compressors are: 15 per cent power saving; 23 per cent more air; not water, air cooled; easier to install; half the floor space; quiet and vibrationless; practically no foundation; low temperature, no carbon and sustained high efficiency.

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Protected Arc Welders With Wide Welding Range

A protected arc welder possessing an extremely wide welding range, increased generator capacity and equipped with an improved cooling system has been announced by the USL Battery Corporation, Niagara Falls, N. Y. Four main poles and four interpoles give full range of welding current with perfect commutation at all loads. A 60 per cent increase in generator welding, from 25 to 40 volts rating, enables the USL welding generator to handle all kinds of bare or coated electrodes without danger of overloading.

Armatures of the motor, generator and exciter are all mounted on a single extra-heavy-duty shaft, eliminating any possible alignment trouble between motor and generator, reducing friction

and giving a more compact design. No resistors are used, thus eliminating another possible source of power waste. Contributing to the general high efficiency of this equipment is a correctly designed fan and ventilating system, which keeps the welder unusually cool, even during long-sustained operation.

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A PROTECTIVE CASE for the older types of watt-hour meters has been announced by the General Electric Company. Die-cast of aluminum, the case not only protects the meter from the weather but also protects revenue, since access to the meter is impossible without leaving evidence of tampering.